569 - List of Birds collected in Borabhum
by H. Tickell -
For rectification of the nomenclature
used, vide 1842. p. 941. note.

# THE JOURNAL OF THE ASIATIC SOCIETY OF BENGAL.

VOL. II.

THE

# JOURNAL

OF

# THE ASIATIC SOCIETY

OF

# BENGAL.

EDITED BY

JAMES PRINSEP, F. R. S.

SECRETARY OF THE ASIATIC SOCIETY.

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VOL. II.

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JANUARY TO DECEMBER,

**1833.**

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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science, in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta; it will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease."

SIR WM. JONES.



**Calcutta:**

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1833.

# PREFACE.

On completion of this second volume of the Journal of the Asiatic Society, the Editor feels it to be due to his subscribers, as well as to himself, to lay before them as briefly as possible, the results of the arrangements which he contemplated carrying into effect at the conclusion of the last volume;—more especially as a somewhat erroneous estimate of the cost and circulation of the Journal found admission into a late notice of the Indian Periodical Press, drawn up by the Editor of one of the morning papers. The Journal is not published, as there stated, by the Asiatic Society, but solely at the cost and responsibility of the Secretary, who was Editor of it before he enjoyed the honour of an election to that office. Since there never has been the least view to profit, either in the Gleanings or in the present work, there can be no object whatever in concealing any information respecting its publication; and it may be useful hereafter to find on record a note of the expences of printing, and the difficulties against which a Journal exclusively scientific has had to contend, as well as the advantages which it has enjoyed, in India at the present time. The following particulars have therefore been extracted from the accounts of the two years now terminated.

| | | |
|---|---|---|
| The amount of subscriptions to the Journal at one rupee per number, including two extra numbers, in 1832, was ........ Rs. | | 5148 8 |
| From this, deducting 20 per cent. commission paid to Messrs. Thacker and Co. for circulating it, .......... | | 1028 11 |
| There remained net subscriptions available, Rs. | | 4114 13 |
| The Baptist Mission Press charged for printing and stitching 500 copies, | Rs. 3742 10 | |
| And the 15 plates cost with printing, | 416 5 | |
| Total | | 4178 5 |

The result of the first year exhibits a sufficient accordance between outlay and return. Of the amount subscribed however, only Rs. 3786 13 have been collected up to the present time, so that in fact there was a deficit of Rs. 392 2.

The alterations which the Editor proposed and completed for the second year were:—

1. The saving of nearly half of the commission paid for the mere circulation of the work (without responsibility), by undertaking that duty with the aid of his establishment as Secretary of the Asiatic Society;

2. As a return for this favor, he proposed circulating the Journal gratis to such of the paying members as should express a desire to take it in.

The effect of this scheme has been as follows:

Fifty members of the Society have availed themselves of the privilege, which has made a deduction to the same amount from the monthly receipts. The number of copies circulated, including those sent to subscribers and societies in Europe, is about 450.

The number of paying subscribers on the list, is 320, which at 1 R. per month, (including one extra number of Buchanan,) would give Rs. 4480.

The expenses of printing 500 copies, of 670 pages,

| | | |
|---|---|---|
| at 4-5 per page, may be stated at ........ | Rs. 2,890 | |
| 144 pages of Buchanan, at 4-8 per page,........ | 648 | |
| Covers, table work, &c. charged extra, ........ | 250 | |
| 40 pages of Appendix, at 5 Rs................. | 200 | |
| 28 plates (18 lithographs, 10 engravings*),.... | 480 | |
| Establishment for circulation,................. | 600 | |
| | —— | 5,068 |

Leaving a loss on the year of Rs. 588, or nearly as much as the subscriptions of the members exempted from paying.

But it must be mentioned, and mentioned with a degree of disappointment which is almost disheartening, that of the flattering list of sub-

* For these the cost of printing and paper only is charged.

scribers above given, 70 have not paid any part of the year's subscription, and as many more are still in arrears; so that a balance of Rs. 1321-8 still remains to be collected. The actual state of the concern is therefore by no means so favorable as could be wished, for it leaves the Editor out of pocket upwards of 2000 Rs. as the reward of his labour for two years ! But he will not for a moment suppose that the balances outstanding are not recoverable : on the contrary the principal difficulty lies in the distance, and the supposed want of a mode of remittance.—Many subscribers are not aware, that letters containing hoondees for the amount may be transmitted *post free* to the Editor.

It will be remembered, that the Bengal Government were pleased to bestow the privilege of free postage on the GLEANINGS and on the JOURNAL, on condition of the publication of the late Dr. Buchanan's Statistical Reports. Under the impression (justly formed) of a corresponding increase of circulation, consequent upon this liberal boon, it was resolved not to incorporate these records in detached notices in the JOURNAL, nor to diminish from its original matter*, but to publish them as a separate work; and one volume has accordingly been completed,

| | |
|---|---|
| containing 356 pages, which at 4-8 per page have cost Rs. | 1,602 |
| And a reprint of the first 108 pages, which became necessary on the subsequent extension of the edition from 300 to 500 copies, | 216 |
| Total, Rs. | 1818 |

This expence has been incurred therefore on account of Government, in return for the postage saved, not to the work, but to the subscribers of the JOURNAL. On the completion of the first volume of BUCHANAN, a second extra volume of an official nature on the Monetary System was commenced, of which 50 pages have been printed with 3 plates, being in fact an expence of more than 300 rupees not included in the above estimate. The Government meantime placed the remaining volumes of Buchanan in the Editor's hands, with an intimation of its "desire that the printing of these records should be continued." It was therefore with no small feeling of mortification that

* Originally 32 pages only were given in each number, latterly 64.

the EDITOR perused the following letter, announcing that the privilege of free postage should cease from June next, especially after having been honored, on an explanation of the nature of the work, with an extension of the same privilege to the Madras presidency, in addition to that formerly bestowed by the Governors of Bombay and Ceylon.

To JAMES PRINSEP, Esq.

Genl. Dept. Editor of the Journal of the Asiatic Society,

Sir,

I am directed to inform you, that the Governor General in Council has resolved, that after six months the exemption from postage, which is now enjoyed by the Journal of the Asiatic Society, shall be discontinued.

I have the honor to be,
Sir,
Your most obedient servant,
G. A. BUSHBY,
Offg. Sec. to Govt.

Council Chamber,
2nd Dec. 1833.

It may reasonably be feared that many subscribers at distant stations may be unable to continue their support to the work, when its cost shall be enhanced by postage; but (should it be impossible, on a proper and respectful representation of the circumstances, to avert the imposition of postage) every means will be taken of lessening the burthen by sending the monthly numbers by the bangy instead of the regular dâk.

On the contents of a volume which has already been perused by nearly all to whom it circulates, it would have been obviously needless to make any remark, were it not desirable to prove that the favors hitherto conferred upon the work by the Government of the country had not been altogether misapplied.

Independently of the volume of Dinajpur Statistics, which forms a model for the use of public officers engaged in collecting similar information, the GLEANINGS and the JOURNAL have been the means of bringing to notice many of the mineral resources of our vast Indian Empire, and of leading to fresh discoveries by the announcement of what had already been found: coal may be adduced as an example,—of which twenty or more different localities have been brought to our knowledge through its pages, where only two were before known. Of the native mineral productions, iron, copper, gold, &c.:—Of the native arts and manufactures, salt, nitre, turpentine, dyes, mills, &c. numerous original accounts have been inserted : catalogues of woods, medicinal plants and drugs : experiments on materials, wood, iron, cement ;—Statistical reports ;—descriptions of newly explored countries and people :—in fact, it would be difficult to open a number of the JOURNAL without finding some information which must possess value in the eyes of a government. Contributions of a more exclusively scientific nature have, in the mean time, continued to multiply, and the objects pointed out as desiderata at home in the geography, meteorology, geology, and natural history of this country, are in the course of rapid and systematic elucidation. So numerous for instance have been the registers of the weather offered for publication, that space could only be found for abstracts of many. There has hardly been time for the collection of materials regarding the tides of the Indian coasts, suggested in the Rev. Professor WHEWELL's circular, (inserted in page 151,) but the attention of those who have opportunities of eliciting the information required, is again solicited to this object.

As a proof of the benefit conferred on science by the free and extensive circulation of a periodical devoted to such objects, the Editor feels pride in alluding to the ardour which his plates of ancient coins have inspired in many active collectors, and above all to the reward bestowed ou himself by the munificence of General VENTURA, the most successful pursuer of antiquarian research in the Panjáb, who has presented to him all the coins and relics discovered on opening the celebrated Tope of Manikyala. They are now on their way to Calcutta.

That extracts and analyses of European science have not been more frequent must be attributed once more to want of space and want of leisure. The Editor would recommend all who seek for knowledge of the progress of science in Europe to procure a copy of the Reports of the British Association for 1832, in which they will find every branch discussed by the philosopher best able to give it illustration. To attempt to shorten those admirable essays would be mutilation rather than abridgment; yet unfortunately most of them are too long for the pages of a monthly journal.

On the subject of orthography of native words, the Editor is driven to make one concession, for which he fears the learned Societies at home will denounce him as an apostate to the system of their leader. Every communication, with hardly any exception, which comes for publication, adopts the Gilchristian mode of spelling, or that modification of it which has been *ordered* to be used in all Government records, surveys, &c. An attempt has been made hitherto to conform the whole to Sir William Jones' method, but necessarily there have been continual omissions, and the contributors in most cases express themselves but ill pleased to see their words transformed into shapes but ill accordant with ordinary *English* pronunciation. The Editor has therefore resolved to adopt the middle course followed in Hamilton's Hindustan, namely, to print all Indian names and words in the ordinary roman type as they are usually written and pronounced, and to place in italics all such native terms and proper names, as are corrected, and spelt according to the classical standard of Sir William Jones: in many cases the latter may be inserted in brackets after the ordinary word.

Where contributors have occasion to illustrate their papers by plates, it will be a great convenience to the Editor to have the original drawings prepared of the same dimensions as the printed page of letter press, to save the trouble and expence of reducing them.

The Editor will not allude in this place to the severe loss he has sustained in the death of some of the most able and constant supporters of his work, and the departure to Europe of others in the course of the past year; since he hopes that a more worthy channel will be found for the record of their meritorious labours for the cause of Science in India, in the Proceedings of the Asiatic Society, to which their names belong, and in which their reputation must ever be cherished with fond remembrance.

1*st January,* 1834.

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Woodburn, Dr. D. Shirghati.
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Zeigler, L. Esq. Setapur.

# CONTENTS.

No. 13.—JANUARY.



No. 14.—FEBRUARY.

# ERRATA.

Page 37 line 35 *for* 'Col. Swiney,' *read* 'Dr. Swiney.'
—— 57 — 23 *for* 'BU-STOM,' *read* 'BU-STON.'
—— 60 — 18 *for* 'grain,' *read* 'gram.'
—— 70 — 29-30 *for* 'in 17 hours 55 minutes,' *read* 'in the year 1755.'
—— 71 — 23 *for* '(5.1)' *read* '(6.1)'
—— — — 28 *for* '(6. ax.)' *read* '(ax. 6.1)'
—— — — 29 *for* '5.1' *read* '(6.1).'
—— 72 — 34 *for* 'the circle,' *read* 'a circle.'
—— — — 39 *after* 'G A' *insert* '(Fig. 3.)'
—— 73 — 21 *for* 'and also touches,' *read* 'and A D also touches.'
—— 74 — 12 *after* 'A B C,' *insert* '(Fig. 4.)'
—— — — 26 *after* 'A B C,' *insert* '(Fig. 5.)'
—— 154 — 5 }
—— 273 — 6 } *for* 'J. S. Lushington,' *read* 'G. T. Lushington."
—— 268 — — *for* 'BC,' *read* 'BG.'
—— — — — *for* 'BE $\frac{1}{3}$ BC,' *read* 'BE—$\frac{1}{3}$ BC.'
—— — — 15 *for* 'to,' *read* 'therefore.'
—— — — 24 *for* 'others,' *read* 'other.'
—— — — 29 *for* 'further from,' *read* 'towards.'
—— 269 — 2 *for* 'valued,' *read* 'salient.'
—— — — — *for* '$\frac{1}{3}$ (ABI+18,)' *read* '$\frac{1}{3}$ (ABI+180°).'
—— — — 7 *for* 'Cardwide,' *read* 'cardioide.'
—— 270, under the word Fahrenheit, insert the following figures omitted by mistake:
633°.2 466 381.2 362.2 356.8 384.8 365.8 452.2 381.2
—— 272, in the mean height of the Barometer at 4 P. M. *for* '.545,' *read* '.513.'
—— 306 line 16 *after* 'Iskardo,' *insert* [Skardo, see mention of this place made by M. Csoma de Körös in vol. i. p. 125.]'
—— 334 — 10 *for* 'craigs,' *read* 'crags.'
—— 314 — 5 *after* 'Indus,' *insert* 'The date PIZ or 117 of the æra of the Seleucidæ, shews this to be a coin of Antiochus the Third: the emblem of a ship was common to Tyre and Sidon, and other seaport towns.' [See CALMET's Dictionary of the Bible, vol. iii.]
—— 315 — 6 *for* 'antiquity,' *read* 'antiquities.'
—— 316 — 17 *after* 'ABHIMANYA' *insert* 'comma.'
—— 319 — 5 *for* '92''.174,' *read* '9' 2'', 174.'
—— — — 9 *for* '118.7,' *read*—'1' 18'' ,7' and *for* '1' 8''.4' *read*—'1'.8'',4.'
—— — — 10 *for* 224.5,' *read* '+2' 24'' 5' and *for* '0 42.7' *read* '+0.42, 7.'
—— 354 note 15 *for* 'scarcely or ever,' *read* 'seldom.'
—— 356 note — *for* 'alternate 10 and 11 syllables,' *read* 'alternate 11 and 12 syllables.'
—— 358 20 *for* 'गर्भा' *read* 'गर्भं.'
—— 390 — 27 *after* 'KARNA,' *insert* '(T. *rNa-va-chan*), and dele the same word in the 29th line.
—— 392 — 7 *for* '*Gnag-hjog*,' *read* '*gnas-hjog*.'
—— 418 — 18 *for* 'stupenduous,' *read* 'stupendous.'
—— 438 — 24 *for* '(vague) 11 0 &c.' *read* '11 10 + 28 = 11 38' by Mr. W. EWER's Chronometer.
—— 449 — 24, 32. *for* 'olefint,' *read* 'olefient.'
—— — — 26 *for* 'heat by,' *read* 'heat due to.'
—— 455 — 7 *for* 'operating,' *read* 'operated.'

Also supply brackets to inclose the following paragraphs:
Beginning with page 446, line 6, and ending page 448, line 28.
Ditto ditto page 449, line 3, ditto ditto page 449, line 34.

—— 472 line 21 *for* 'lucertina,' *read* 'lacertina.'
—— 489 — 36 *for* 'extent of coast,' *read* 'extent of land frontier to the East, North, and West of the British Possessions in India.'
—— — — 18 *for* 'thus weighed, the,' *read* 'thus the.'
—— 492 — 12 *dele* lifts.
—— 205 — 17 *jor* 'lime and stone,' *read* 'limestone.'
—— 263 — 7 *for* 'Ludiya,' *read* 'Sadiya.'
—— 309 — 36 *after* 'building,' *insert* (See plate xix).
—— 549 — last *after* 'the fossil shell,' *insert* '(See plate xx).'

# DIRECTIONS TO THE BINDER.

The sheets of Buchanan's Statistics are to be separated from the monthly numbers, and (being now complete) to be bound as a separate volume. The sheets of Appendix headed "Indian Monetary System" are also to be separated, and reserved to form part of a future volume.

The Plates may either be bound up at the end of the volume, or placed in the following order:

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# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 1.—*January*, 1833.

### I.—*Continuation of the Route of Lieutenant A. Burnes and Dr. Gerard, from Péshâwar to Bokhâra.*

[The same gentleman who favoured us with the sketch of the route of these travellers to Péshâwar (vol. I. 145) had prepared a continuation of his account, derived from the private letters of Dr. Gerard, for insertion in the present number. While printing it, however, we were, through the kindness of Captain A. Gerard, put in possession of copies of his brother's more recent letters to himself: we have availed ourselves of both; merely arranging the extracts in the order of the places visited; and we beg to offer our acknowledgments to both of our contributors for their permission to give publicity to private correspondence, in the absence of any direct communication to ourselves, relative to a journey which excites so much interest.—Ed.]

The travellers reached Péshâwar about the 15th March, Kabúl on the 1st May, Khulm, on the 30th May, and Balkh, before the 10th of June. They appear to have made twenty-six marches to the latter place, and to have traversed a space of about five hundred miles. They were induced to stop about 61 days at the principal cities on their way: of which 34 were spent at Péshâwar, 17 at Kabúl, and 10 at Khulm.

"The trip from Péshâwar to Kabúl, was very harassing, and to me, ill of fever, superlatively so. The country is naturally difficult, and our merciless guide drove us about regardless of heat and cold; rain, and shelter. Our stay in Kabúl was too short to recover such an exertion, and I left that place in the same state of health as I arrived. Dost Muhammed Khan's treatment of us was highly satisfactory, and more than we durst have relied upon, considering the position he occupies. We had none of the assiduous attentions and caresses of his brother at Péshâwar: his character does not admit of familiarity, while his situation equally forbids it; but his civilities were of the first estimation. Kabúl is rising into power under his republican spirit of government, and I should say is destined to an importance in spite of itself, for in every view it is the key to India. It is astonishing how much the country is relieved by the overthrow of the royal dynasty; and with respect to the latest reigns of the Timúr family, the change in the condition of things for the better is not more wonderful than it is natural. In Shah Shujah's haughty career, there was little security in all we most value, and robberies and bloodshed disgraced the precincts of his court. Dost Muhammed's citizen-like demeanor and resolute simplicity have suited the people's understanding; he has tried the effect of a new system, and the experiment has succeeded.

My fellow traveller pursues a very good plan for any political object, by keeping up correspondence with every one who has treated him with civility; particularly with our friends in Kábul and Péshâwar. We may soon have to ask Sultán Muhammed for a supply of coals to navigate the Indus; mines have been discovered; and they ought to be worked upon scientific principles. Moorcroft searched in vain for seams, but no doubt the people took up the hint. The specimens which were brought to us indicate the variety to be what is termed anthracite, or slate coal, and consequently as fuel is very meagre; but this may be the exterior crust or shell, and when penetrated, a richer material may be discovered. We saw it in thin plates, of a concave-convex form; the fracture was grey, but without any lustre, and it soiled paper; at first I took it for graphite or plumbago, and I shall not be surprised if that mineral is contiguous. It burnt by the flame of a candle, and gave out a dense gas. We should have sent a specimen to Calcutta, had an opportunity offered. The mine is in the district of Kohát, in the plain-ward hills, and therefore most conveniently situated at the navigable extremity of the Indus. I hear there are mines in Cuch, which thus sets the question of physical capabilities at rest, and supplies the only remaining desideratum. Sultán Muhammed Khán would be delighted at the proposal of working the coal seams, for reciprocal advantages must flow from such a medium. There are also sulphur seams in Kohát; and adjacent, even conterminous with that estate, is the fertile country of the Wazírís, famed, I believe, for a superior breed of horses, and report says, rich in indications of auriferous and other precious ores. Moorcroft paid a visit to that district, and I suspect that he was aware of its mineral deposits. The whole of Afghánistán teems with the germs of metallic treasures, but it may be long ere we become better acquainted with those hidden stores. I was disappointed in not discovering any traces of shells or fossils on the route to Kábul, but we durst scarcely look around us. I was too ill besides, and our journey was too precipitate for any useful purpose.

" We entered Kábul after a fatiguing journey at four o'clock, having been 24 hours from the last encampment, and with the exception of a short slumber our guide unwillingly allowed us at midnight, and my doze upon the raisin bags of a small grocer's dukán by the road side, where my horse made his repast while I reposed, I may say, I was in a high state of corporal suffering during that long period, with a fever raging in my blood, and a fiery heat in my face, which has latterly burned to parchment. I need not describe Kábul to you, who have travelled over the same ground, and I should certainly fail in my attempts, having seen but little of the place. One is not disappointed in the display, after the uniformly arid aspect of the surrounding country; but it is in this contrast, rather than in any peculiar scenery, that we are delighted with the spot. Frail mud houses, which seem only to be renewed by the accessions of patch-work, form a penurious threshold to a great entrepôt of commerce; but when the bazar opens, one is amply gratified by a scene, which for luxury and real comfort, activity of business, variety of objects, and foreign physiognomy, has no living model in India. The fruits which we had seen out of season at Péshâwar loaded every shop; the masses of snow for sale, threw out refreshing chill, and sparkled by the sun's heat: the many strange faces and strange figures, each speaking in the dialect of his nation, made up a confusion more confounded than that of any Babel, but with this difference, that here the mass of human beings were intelligible to each other, and the work of communication and commerce went on. The covered part of the bazar, which is entered by lofty portals, dazzled my sight, even quite as much as the snow of the Himalayan peaks, when reflected against the setting sun. In these stately corridors, the shops rise in benches above each other, the various articles with their buyers and sellers, regularly arranged in tiers, represent so many living strata. The effect of the whole was highly imposing, and I feel at a loss adequately to describe the scene presented to our eyes.

" Our stay at Kábul furnished few objects of interest; the time passed rapidly, and my own ill health prevented me making any exertion. We were Nawáb Jabar Khán's guests, and though our quarters occupied one side of a square which was a rendezvous for courtiers, we were infinitely more at liberty than at Péshâwar, and even quiet till we were roused up by Mr. Wolff, who amused us greatly by his various adventures. As long as he staid at Kábul, we were in a perpetual stir; the house was filled with Jews.

" The climate of Kábul was considerably colder than I was prepared for, when the barometer announced an elevation of 6000 feet. The morning temperature varied between 43° and 47°, and 66 degrees was commonly the maximum of the day; while, in the house, 61° and 63° were the extremes; and this temperature was during the first half of the month of May. This state of the atmosphere is far below that of Simla, but as there are no periodical rains, the summer heat increases till August; and, notwithstanding that, Baber talks of sleeping throughout the year with a *pustín:* in the dogdays, the air is warm enough to make the tops of the houses a comfortable place of rest. Kábul, like Kanáwar, is indebted for its fine climate and luxuriant gardens to the aridity of its atmosphere, and to irrigation. The snowy range, that lies on the north-west, contains within its ramifications many thousand orchards, from which all the dried fruits that fill the bazars of India are supplied. The majestic rhubarb grows there wild, and its succulent stem is one of the luxuries of every house; it has a grateful acidity. Fresh snow fell frequently upon the neighbouring mountains, but none of the peaks appeared to attain a greater height than 16,000 feet. The summits of the true Hindú Kúsh were visible on the north, like heaps of pure snow. Macartney is out at least 20 miles in his latitude of Kábul, which is too low. Rennel's position of it, and also of Kashmír and Kandahár, will be found most correct. Burnes took the elevation of the pole, and it is close upon $34\frac{1}{2}$°. The barometer showed a little above 24 inches, and water boiled at 202°. I need not mention our treatment by Jabar Khán, whose character is so well known. Common words would not express the friendly attentions he heaped upon us. He is much too good a man to be connected with the family: his whole pride of distinction is in charitable actions, and a modest, but confident demeanour of person. Of his brother, Dost Muhammed Khán, we have every reason to speak with the greatest respect and satisfaction. He is diminutive in stature, with a common face, which you would pass a dozen times without remark, and fail to distinguish in a mob. He has no state; a single attendant follows him, who is generally the best dressed of the two, and a stranger, fresh from an European or Indian court, would mistake one for the other. His habits correspond with his appearance, and every thing about him partakes of the simplicity of character that raises him above the multitude. It is in conversation, when his countenance becomes brightened with intense animation, that the mind of the chief developes itself, and evinces his intellectual power with the happiest effect.

" The Russian Church is held in high estimation at Kábul, and the Kábulís meet with much attention from the subjects of the Autocrat, while they are scarcely noticed beyond the Satlej; these opposite receptions of course leave strong impressions on the feelings of individuals.

"Dost Muhammed gave us six introductory letters (one to the king of Bokhara); and on the 18th of May, we took leave of Kábul, under the protecting guarantee of a Nazir, a man of high connexions and repute, who however proved himself anything but agreeable. The opportunity was too favourable to require consideration, the man's character was to be our passport, and as we anticipated difficulties in Morád Bèg's territory, we thought ourselves fortunate; although we afterwards repented.—Our ill-favored guide was proceeding to Russia, to recover the property of his brother, who died there. On this occasion, Dost Muhammed Khán wrote a letter to the Emperor!!"

"The passage of the Hindú Kúsh presents no difficulties, and viewed in any way, shrinks to insignificance, compared with those portions of the snowy chain which you and I have seen. Even as a barrier to an invading army the difficulties are far from formidable by this route. The great pass, which is alone named Hindú Kúsh, is even more accessible, though more lofty; we would have taken that route, but for the dread of encountering Morád Bèg. The pass is worth seeing, especially as we heard some strange stories about flights of birds being so much baffled by the strong wind, that they no longer could fly against it, and actually took to walking for a change, when vast numbers were killed by the natives. The emperor Baber mentions the same thing, and the fact would seem to argue great elevation. The Hindú Kúsh has no longer the configuration of the Himalaya; the steep cliffs of hard compact rock, which characterise that ridge, scarce appear here at all, and few of the peaks attain any remarkable altitude. The most prominent point was Kohi Baba, and I do not believe it rises to 19,000 feet: all the neighbouring heights appeared in bluff masses, resembling the contour of the mountains upon the Chinese frontier and the interior of Kanáwar, which is evidently the effect of a different structure; and as far as I could judge from the nature of the road, wherever the bare rock was exposed, the elements of the whole range are of the class of formations termed secondary; and as we penetrated into the country, the hills changed into slate, gravel, and even mud, which last mixed with loam and calcareous rubble, all indurated by alternations of weather into a rugged hardness, compose the formation of the Bameán "Búts," or idols, which most people believe, and the natives themselves represent, to be cut out of the solid rock. But to return to the Hindú Kúsh:—we rode up to the pass, which is scarcely 11,000 feet in height; the snow lay deep upon the summit, but was fast retiring before the ardent sun, and the slopes were only speckled at that limit. The descent was quaggy and tedious, but there was not much of it, and villages appeared at a general level of 10,500 feet. The second pass was nearly 12,000 feet, the adjoining villages hampered by the snow projected their grey turrets through the uniform field of whiteness. The third pass was inaccessible by horses*, and we descended by the hollow of a gorge into a dell that drained off the waters towards Kúndúz and the Oxus. When I beheld the opposite course of the streams, I began to ask, is this the only range that separates Khorasán from Turkistán, and the valley of the Oxus; and when soon after I found our level to be close upon 5000 feet, I conceived that other and loftier ridges crossed our route; but a few more days, and the 13th from Kábul, brought us upon the plains of Tartary, for that name is specifically apposite in the region of Asia, adjoining Bokhára and Samarkhand. My understanding was now enlightened, for I had but vague and ill-defined ideas of the geographical nature of this tract, but in one respect I was not wrong—I never believed there could be any flat expanse, similar to the plains of India: and the fact is so, and could not have been otherwise; and long after we had entered the open country, and crossed the Oxus, a range of snowy mountains on our right-hand (our face being then towards Bokhára), confirmed my conjectures. We were both much surprised at such a sight, particularly as it was of so transitory a nature as nearly to elude our comprehension: it was almost sunset, and the outline, just lighted up, gleamed for a few minutes, and faded into a dim mass. The spectacle was full of grandeur, and left us wondering; for we never saw another trace of the range, or its desolate snows.

"The map gives us very imperfect notions, I should say none at all, on the subject; for the mountains, marked there as snowy, could not have been in sight, and those that seem to indicate their position, are not only black, but occupy a very limited space. Now, heights bearing perennial snow, and far exceeding that marginal boundary, do not often start up abruptly in patches or isolated ridges from a flat expanse of plain; as the routes to Yárkund cross them free of snow at this season of the year, they may not be so elevated as they appear. When thus in the open plains of Turkistán, the thought (which had often amused us) recurred, is the Hindú Kúsh the true limit of the great snowy chain that forms the northern frontier of British India? As to the appearance on the map, the illustration is correct, as far as it goes; but we naturally, and upon cosmogonic grounds, ask,—where is the Himalayan ridge? and where should it go to, but north. It (unfortunately for

* I should rather think my brother means inaccessible on horseback, A. G.

geography) is unknown by that name, and amidst the confusion of such unmeaning designations as Hindú Kúsh, Caucasus, Súféd Koh (White Mountain), as if snowy mountains should be any other color: to be sure, we have heard of red, to which the map adds blue mountains, white mountains, cloudy mountains, and black mountains (see the map in the octavo edition of Elphinstone's Kábul); besides Taghs and Tukhts, innumerable; and lastly, Parapamisus, which is a fine sounding name, but it unfortunately happens not to exist; there are also Kara or black mountains, which are also salt. Is not all this too bad?—In seeking for the continuity of the Himalaya, we must go north of Ladák, and the sources of the Oxus, where a vast tract of lofty summits will be found to trend towards the skirts of Yárkund, and somewhere near the heads of the Oxus and Jaxartes, to define the slope of the country to the north-west; this will bring the high plateaux, north of the Indus, within more precise limits. All this tract, which is by no means very remote, is still unseen by the eye of civilised man.

"The Búts of Bamean represent a man and woman of colossal magnitude, carved in the cliff of the ridge that bounds the valley on the east. On approaching them, I saw from the very look of the hills, that they could only be moulded in some soft calcareous substance; yet a very intelligent man, a Hají Baba, who was with Moorcroft at the spot, insisted that the figures were in the solid rock, which would indeed have been an anomaly, as the whole of the neighbouring hills and the dell itself is a diluvial, perhaps an alluvial, deposit of mud, clay, and conglomerate. I was certain in my opinion, and took a bet of 100 *groats* to one, with the old Hají, that they were mud, and so they proved to be. A piece of a toe, or part of the nose of one, will decide their structure: it is not gypsum. Though it is rather a disappointment to find mud instead of granite, still these idols are very curious objects, both with regard to antiquity, and as memorials of an epoch, the history of which eludes our research. The written accounts, if they are not vitiated by mythological figures, assign their formation (creation) to the year 56 before the Christian era, which is far from extravagant, considering the nature of the records (Mahábhárat), which give that date; but without attending to these, it is almost certain, that they existed before the time of Muhammed, and when the country was possessed by the kafirs under the dominion of Zohák, whose reign was antecedent to Christianity.—These august idols were mutilated both by Timúr the Great and by Nádir Shah: the former discharged arrows, and the latter fired shots at them. Some faint traditions of Alexander the Great are in the mouths of some of the inhabitants; but there are so many Sikandars that it is almost impossible to extricate the right one. We saw nothing like Greek inscriptions, but heard of many near us. A question readily occurs—is the material of which the idols are constructed calculated to resist the impression of hundreds of years, not to think of a period approaching to thousands? Had I not myself been fully aware of the preservative nature of the climate in the Trans-Himalayan regions, and seen antiquity represented in mud walls, books and other works, which we consider perishable, I should have been staggered at the idea of the Bameán idols' claim to so remote an origin. The aridity of the atmosphere here is pretty similar to that of upper Kanáwar and Tibet, where a thing neither rots or decomposes, but falls to dust in long ages; and the substance of the figures is of that kind which becomes indurated by exposure to the air, and like the mud upon the roofs of the houses, acquires the hardness of the surrounding kankar. Near this we passed a ruined fort, said to have been built in the days of Zohák; the slender walls of unburnt brick were perched upon cliffs, which time had rendered inaccessible. Close to the Búts are the remains of a mud castle, about which some curious traditions are related; but I omit them, lest you might think me as credulous as the people who related them.

Without thinking of the idols, over which superstition and undetermined antiquity have bestowed a false character, there never was a spot better appropriated for fabling the extravagancies of nature, or raising ideas of bhúts and spectres. As to the káfirs, their domiciles yet remain: desolation is not the word for this place, the surface of the hills is actually dead; no vegetable trace is to be seen, all is parched up, and as it were baked white, and scoriated by the sun's rays; such is the horrid aspect of this part of the country, to which the caves of the káfirs have added a savage impression. These are still inhabited, but their first possessors have long since disappeared; the sides of the mountains are full of excavations, presenting to the approaching traveller some thing like a honey comb; whole families occupy these recesses, living in smoke and darkness, of which they seem to form a part, in their black figures.—One of the idols is actually tenanted, and high upon the acclivity are seen isolated nitches and black heads peeping forth. At night, the moving lights and yells of unseen people have a singularly wild effect, and one dwells in the contemplation of the scene, till it actually appears one of an infernal kind, fit only for such companions as bhúts and demons. Burnes took sketches of the whole.

"A Persian of our party, who had been at Moscow, had drawings of the idols, which he affirmed were an object of enquiry in that country, and that he had made them at the request of the Russians; and when they send to Bokhara for coins and other antiquities, there is nothing surprising in their extending research to Bameán. The figures appear to my eyes more like designs of Búdha than any other; their physiognomy at least resembles that of images I have seen in Kanáwar and Tibet. They are mentioned in several old books, and it is strange that any mystery should prevail about the age or events of which they are symbolical. We can however now assign them their true site and position in Hindú Kúsh, which were to us even at Kábul extremely vague, and to people in India, utterly incomprehensible. Bameán has its site upon the northern declivity of Hindú Kúsh, and within its lofty ramifications, in a dell or valley, which throws its waters into a tributary of the Oxus, that passes through Kúndúz. The map places it south of the snowy ridge.—It forms the extremity of the Kábul dominions, and is elevated a little above 8000 feet. The climate was rude and disagreeably cold on the 20th of May, and the grain crops were only sowing. An idea has prevailed that Bameán is a pass in the Hindú Kúsh, or in a more southernly ridge; but it is quite across the chain, although environed by snowy heights. On the north, at the head of the dell, the mountains are depressed to a hollow, or pass between 10,000 and 11,000 feet, and beyond that the country subsides in undulations to the Oxus.

Hitherto we had adopted no particular precautions to maintain our disguise, except evading the gaze of people, passing either unobserved, or as Armenians; but on entering Morád Bég's territory, we rolled our heads within our turbans, and this saved our faces from the scorching sunshine.

At Dwap or Doab, where Mr. Wolff was robbed, we apprehended danger, and provided an escort from a neighbouring brigand chief. In the hollow of a pass, we met a káfila of very fine horses: they were all safe, and quite unaware of their escape, as afterwards appeared. We had no idea of any alarm, but as we were descending the slope of the pass, a body of robbers appeared—they had lost their aim in the horses, and were now coming up to a couple of camels, the last remains of the káfila.—I was behind, as usual, and although I saw, I could not understand the manœuvres of our party, and kept lingering on till met by one of our servants, sent back to bid me gallop my horse. The robbers were very fair and candid, as I thought, suspecting who we were: they sent one of their party to communicate with us, who on our side was met by a young lad, the leader of our escort, and son of a neighbouring chief, who in his turn becomes freebooter, and to these mutual interests in plunder, and partly to our force, we owed our escape. They immediately declared themselves, and their disappointment in the horse káfila, intimating with a good deal of honesty, that they ought to have had a recompense in us. Notwithstanding this result, our káfila-báshí was very assiduous in his exertions to send the baggage mules and foot-travellers out of the way. The fate of the camels and their drivers was inevitable, the latter seemed to have lost all resolution, and between fear and hope they shrieked and stood still. We were looking up from a dell, and eagerly watched for their escape; but had to witness both them and the camels carried off, the former to be sold in the public markets of Bokhára. It is this ultimate object that makes the predatory work so odious and terrific. Highway-robbery, like slave trade, when pursued systematically, loses many of its horrors, and much of its criminality, (not that I am at all countenancing either.) In fact, whenever acts become a custom of a country, self-interest deprives them of violence, and people club together for the sake of confederate advantages, frame laws of honor, and pursue their profession upon principle, and the state itself shares in the benefits of system; kasids, or letter-carriers are held sacred, the property of individuals is spared, and life is rarely lost. Many of the chieftains, such as Morád Bég, have a personal interest both in plundering káfilas, and in making slaves, and take turn month about with their feudatory vassals. Our friends, the robbers, kept within our sight, moving slowly along the top of a ridge, and occasionally reminding us of our good fortune. We were now fast descending towards the basin of the Oxus, though the country continued rugged, and now and then betrayed its altitude in hoary peaks. At last a mild wind from the north, and a haze in the horizon, announced our proximity to the plains of Tartary. The few latter marches were rather irksome, on account of the disguise we thought it prudent to adopt: the instant we reached our ground we were covered over with a heap of clothes. One morning, we found ourselves in juxtaposition to the chief of the place, a man of disrepute and a deputy of Morád Bég's: he came to dine with our káfila-báshí. We were lying amongst the long grass, and stole away a few yards, where we reposed with confident security, and listened to his conversation. Here we had troubles of a different kind, scorpions which stung our servants, and a little farther on, snakes; the heat too was already considerable, although our elevation was about the level of Subáthú (4200 feet), and our latitude above 36°; but we were refreshed with a little rain. However uncomfortable such things may appear in a letter, in reality there was much amusement, and our most serious misfortunes (apprehensions I should say) excited an interest that was far from disagreeable; even Morád Bég himself appeared to me a plausible enough sort of a savage. At midnight, on the 29th of May, our káfila-báshí warned us to be off: we scrambled awkwardly through a marsh, and the day broke while we were yet in the deep hollow of a torrent; we hoped still to reach Khulm (which was to terminate all our doubts of safety) before the bazars were crowded, and finally, soon after sunrise we emerged upon the plains of Turkistán; the pass through the mountains was between mural precipices of tremendous grandeur; and I was so much struck with the solitude of the spot, that I conceived we might evade observation in some of the recesses of the cliffs, and escape the sun's rays at the same time, and resume our journey at night-fall towards Balkh. On opening upon the new world, the first objects, as usual, were mountains, at the base of which rolled the Oxus; the river itself was not in the sight, but a regularly defined haze indicated its course, a phenomenon I had before remarked in the Satléj, and we ourselves had observed in the Indus, which arises from the difference of temperature between the stream and superincumbent stratum of air. We regaled our eyes with the regions of "Trans-oxiana." The respectability of our party saved us any trouble at the custom-house. We were not searched, and pushed through the streets, staring every one in the face. We entered a caravanserai full of people, and lodged ourselves amongst tea merchants, and traders in Russian furs, and people of all nations and descriptions, as if nothing had happened; and I am not now going to waste time on the subject. Suffice it, that we found ourselves in the safe custody of Morád Bég, and after ten days rather anxious suspense, escaped from all apprehensions, and departed under his aid and protection!! How we extricated ourselves from a scene which was at one time tragic, at another comic; contortion, trickery, and sordid interest on the part of the Nazir, to make the most of us; fear and folly on that of others; self-confidence and friendship in a few; wonder, expectation, and the most stupid credulity in Morád Bég himself, and altogether a drama in which the chief actors struggled for the loaves and fishes in our pockets; poor Morád Bég got nothing by his Oozbek simplicity, while we who sustained the whole scene were never thought of, except it was to produce more money. My part in the play was rather that of a spectator than of a performer, and might appear easy; but I had taken an early interest in the swamps of Kúndúz and arid sands of Talikan, (as you will recollect,) the scenes of poor Moorcroft's misfortunes, and Morád Bég himself became in my eyes an object of attraction, by his savage conduct on that occasion; and however strange it may appear to others, as I fancy it did to Burnes, our situation at Khulm only struck me in the light of an opportunity I should have of realizing former prospects, and the idea of meeting the chief of Kúndúz, either as a tyrant or a friend, was by far from the least cherished of my adventures; but I was doomed to disappointment, and for some reason or other, my sunburnt face, silvery beard (which is now black enough), and ignorance of Persian, (though Turkí is the spoken language in Kúndúz,) were supposed by the catchers of the loaves and fishes to be unfavorable to our disguise; consequently I was left behind, and Burnes alone paid Morád Bég a visit at his country seat. We had been summoned to his presence to give an account of ourselves, and to remove the suspicions which rumor had attached to our character. Neither Burnes nor I anticipated any personal danger, but the chance of restraint, or at least incalculable delay, and the certainty of a pecuniary sacrifice, or absolute deprivation of all our resources, had sufficient alarms to make both of us anxious for the result. Bad as the repute of Morád Bég was, and too surely deserved, by his treatment of Moorcroft, I could not resist the idea that we should find him better than he was described; and though poverty and power together might plead an excuse for robbing us of our money, sordidness itself could not wholly destroy the common sympathies of our nature, and make him stare forth the naked savage. The self-will of an arbitrary tyrant, enjoying a penurious chiefship, might induce him to an act of extreme rigor; but self-interest would scarcely allow him to trespass the bounds of discretion, and insulate himself from the feelings of all around him. Burnes successfully appeared before Morád Bég, as an Armenian watch-maker from Lucknow, and it turned out, that the blackest person of our party would have answered equally well; with the above simple reply, the despot of Kúndúz and king of terrors was satisfied. Could this be, amidst the game that was playing, the gold that was shining through us, promised bribes and open trickery? besides, Morád Bég had heard of us at Péshâwar and Kábul approaching with five lak'hs of rupees, and the custom-house officers were looking out for us; yet all this and much more happened, and if there was no delusion, confirms the character of the Oozbeks as given by Elphinstone, for unsuspecting candor and the most stupid credulity. Burnes passed a pleasant-enough time at Morád Bég's country-seat, drinking tea all day, and eating the leaves, according to custom, after the manner of the ancients; and having been presented by an honorary investiture of some new clothes, he returned to Khulm, a distance of 70 miles, without dismounting, much better dressed than when he left it.—Moorcroft, at the very same place, in his flight from Morád Bég, and for the safety of his life, made his remarkable journey to Talikan upon a single horse, with grain in his saddle bags; the distance, as then stated in the Government Gazette, 130 miles, seems to be excessive. Previous to this final result of Morád Bég's curiosity, we thought of escaping to Mazár; but we were watched, and this would have been a feat of senseless heroism, as we were liable to certain danger on the road from robbers. Morád Bég's courtesy and attentions to us as Armenians, in ordering an escort of 50 horsemen to see us beyond his frontier, did not allay our apprehensions for our liberty; and as the scheme, as well as ourselves, were notorious throughout the caravanserai, we made every haste, and next morning's dawn saw us on the way to Balkh. Our own people, scarce aware of our plans, had provided us but meagrely, for a ride of 30 miles under a burning sun, and I had neither clothes nor any thing else. We were now literally flying from ourselves, and the protection of a man whose very name we dreaded, and whose treatment of us is veiled in an obscurity, that leaves it doubtful, whether we at this present moment stand towards him in the relation of friends or enemies. Subsequent travellers may remove the uncertainty, which is of more consequence than appears to the eye, but in this respect our experience can prove to them no guide.

The journey to Mazár was rather trying, over a bare, baked soil, without shade or water; the temperature of the air was 100°, and that of the sun's rays much greater: my face at least was completely burnt. Our escort left us at what appeared the most dreary point of the road, and it was actually the most dangerous; our horses were wearied, and that which I rode stood still in a place where our káfila-báshí said it was imprudent even to look around us. We entered Mazár unknown and unsuspected, and it was perhaps fortunate, as the people are intolerant bigots and disreputable in every way. Piles of snow, and the most delicious apricots were in abundance. It was here that Moorcroft's property was seized and plundered: we felt extremely anxious to ascertain if any papers or memorials still remained, and the fate of his books, which we heard were in the possession of the chief; but prudence constrained us to pass over the scene in silence.

We had here a contention with our guide, who enacted a scene on the occasion, partaking at once of the pathetic and the furious.—Burnes was fortunately on horseback, and had the whip hand in case of necessity—I mean, the advantage of escaping from an irritated Muhammedan, who had only to proclaim us infidels and revilers of the prophet, and there would have been tragedy indeed.

Thus terminated our intimacy and connexion with the man, to whose care and protection we had been consigned, by the brother of Dost Muhammed Khán, for our safety to Bokhára; we never spoke again. The Syud, Mr. Conolly's friend, whom we met at Péshâwar, and whose grateful feelings for the attention and liberality of the Governor General had interested him in our journey, to the extent of promising to protect and conduct us to Bokhára, we left at Kábul, ill, and otherwise too much engaged in his own affairs, to assist us in any way. Thus deprived of the dependence we had in these people, and without any introductory letter to the king of Bokhára, (the Nazir having lost or wilfully destroyed it,) we had to make the best of our way unassisted.

On the road to Balkh, we turned aside to see poor Trebeck's grave. Muhammedan bigotry had yielded so far, as to permit his remains to be deposited within an enclosure or garden: a mulberry tree sheds its fruit over the spot. We had heard this young man spoken of every where with the highest eulogies, and it was a satisfaction to us to have visited his lone sepulchre. We wished to leave some record of the spot, but although it is possible to get a slab-stone here for his and Moorcroft's graves, it is doubtful how such a memorial would be respected, unless we ourselves had witnessed its erection.

On entering Balkh, we were met by two custom-house officers, jolly fellows, and one of them a Túrkoman; but from the nature of their employment, rather boisterous and abrupt: they stopped our horses, bade us dismount, and said we must be searched. A little surprised, we kept our seats, and assured them we were not merchants. "We must see what is in those saddle bags," said they. Burnes then dismounted, and the Túrkoman began an examination of his person, passing his hand over his watch—what have we got here? Ah "Saat," that is a useful article to travellers—very well, have you got nothing else, no tillas (gold coin), and before Burnes could reply, he with much good humour said, Come, come, you know as well as I do, that people cannot travel without money; now, how many have you? Twenty, said Burnes, offering to untie them from his waist. Don't trouble yourself; there is no occasion, Your word is every thing, I am satisfied; and pointing to me, (I had not dismounted, and was thinking what to say,) what has your companion?—the same. Thank you, replied the Túrkoman, you are gentlemen. I wish every one was as ready in their answers, they would save themselves and me much unnecessary and awkward trouble. Your names, said he. Sikandar Armení and Gerard (with the French pronunciation). The tax upon our money was a tenth. Hindús pay a twentieth; and Muhammedans, a fortieth. We had no tillas except those tied about us; but the Túrkoman said, Make yourselves easy, I'll call upon you at the caravanserai. Such civil treatment, in such a country and by monstrous Túrkomans, deserves to be mentioned."

"We were now in the most ancient and renowned city in the world, and when we looked at the ruin and recalled to mind, the dynasty of Bactria, and in later ages the thrones of Jenghiz and Tymúr, with the neighbouring scenes of Bokhára and Samarkhand, the present and the past, it gave us a lively idea of the countless revolutions which had rolled away. There was nothing here by which we could recognise these memorable epochs, and judging from the aspect of the few inhabitants left, the spot seemed more suited to the dead, than as a place of abode for the living. The ruins, which are mostly of mud, are very extensive; but they only mark the modern site of the city. The insalubrity of Balkh is proverbial, and this calamity may be traced to the very effects of its former greatness. The eighteen beautiful aqueducts, by which it was irrigated, no longer guided by the art of the husbandman, have spread their waters over the face of the country, and transformed its fair landscape into a stagnant marsh. Here the Nazir had another opportunity of resuming his tricks: in our difficulties with Morád Bég, we had intrusted him with our passports; and forgot them at Mazár. He now pretended to have lost them, and we were preparing to visit him vi et armis, when the intercessions of our Hajee restored them without more acting. From Balkh to the Oxus is almost a desert; camps of Túrkomans occur in some places, and the sand hills are well clothed with bushes. The high road was considered unsafe, and we followed the downward course of the valley. At one spot only we required an escort of Túrkomans, who are themselves the robbers, but find it more advantageous to compromise their habits by an easily earned recompense. They were the first of the race we had seen, and their peculiarities struck us with surprise and interest. Their features, their dress, address and gay agility upon horseback, were all favorable; and, in fact every thing about them, but their modes of life and predatory customs, were respectable. On the 15th of June after travelling twelve hours, the day dawned upon the shores of the Oxus, and at nine o'clock, we were encamped upon its margin; a point that had so long been in prospect, and glimmered through so many vague and ill defined ideas of difficulty and peril, was now at our feet, and we were not satisfied till our feet were actually in its cool waters; and here we sat, slept, and passed three entire days, with more ease than we dare expect upon the banks of the Ganges, for here we had neither alligators nor enemies of any kind to dread.

The Oxus is a splendid river, here exhibiting an expanse and volume fully equal to our expectations, or its appearance as given in the map; but I should say of inferior magnitude compared with the vast extent of country of which it is the drain, and where deserts and arid mountains occupy so large a portion. The Hindú Kúsh generates but a scanty tribute from its snow, and but few supplies are derived from the north; the great body of the water coming from the south-east and east, where the intersections of the Himalaya define the course of the streams to the Indus, and branching northward, give origin to the rivers which wash the Chinese frontier of Yarkúnd and Kashghar, the whole of which tract from the limit of Kundur in one direction, and Bokhára itself in another, is a blank in geography. It is true the sources of the Oxus are pretty well ascertained, and the travels of Meer Izzat Oolla have sketched the configurations of the country north-west of Ladák; but the height, extent, and nature of the mountains which intervene between Leh and Yarkúnd, and along the north-west branches of the Indus and Hindú Kúsh, are wholly unknown.

The stream of the Oxus is muddy, like that of our Indian rivers; but confined within marginal banks bearing a stiff vegetation, it has a more regular channel, and rolls with greater rapidity; where we crossed it, the expanse of bed was divided by islands, and the current assumed various degrees of size and velocity, the largest with a rate exceeding three miles per hour and a depth of 20 feet. As no rain falls in this country, the whole mass of water is liquified snow. It is impossible to form a comparative estimate of the actual bulk, but it can scarcely equal the Indus at Attok. The ferries are ill supplied with boats, but the boats themselves are substantial fabrics, and are built more after the model of our sloops than any thing I have seen in India; but the people have no idea of navigation; their oars are of the rudest kind, only one or two in a boat, but the chief impulse depends upon horses, which are fastened on each side of the bow, and, by their exertions to swim, drag the boats across the currents. I never heard of such a practice, and almost doubted it till we witnessed the spectacle. There are no fords downwards to its debouche in the Aral, but in winter it freezes over in several places, sufficiently strong to bear the transit of the káfilas, which is singular in a parallel of latitude under 40 degrees, and at a very inconsiderable elevation.

The bed of the river, where we crossed it, scarce attains the level of the Punjáb rivers, in the line of our route, as well as we can estimate by the boiling point of our thermometers, which are the only means left us. Prinsep, in a letter to Burnes, reminds us of this resource (in the absence of barometers), to verify the levels of the Aral and the Caspian; but this method (at least with common thermometers, where the divisions which are so small, answer to so large an equivalent) is scarcely appreciable to the extent of 200 or 300 feet, which those land-locked seas are supposed to be depressed below the surface of the ocean. In this dry climate, the horary variations of the barometer would amount to more than the above quantity, but we shall lose no opportunity of using every means to confirm so curious a conjecture, if it is not already settled. From the Oxus to Bokhára is more or less a desert tract, and the surface of the soil undergoes every modification of barrenness, from the hills just sprinkled with vegetation, to the hard-baked floor and dead sand heaps. The first four days no villages but camps of Túrkmans were passed. The water was either salt or saliferous, and owing to our folly in trusting to information which is in its nature imperfect, as the springs of potable water are as variable as the sand hills, we suffered excessively from thirst, the sun raged with a burning heat, and we had no defence against it but our clothes. The wind of the desert dried* us like parchment, bnt the nights were cool, and often cold: this however did not take place till towards day break, and the few hours sleep we then got were deliciously refreshing, after heaving up and down upon a camel's back all night. The face of the country was very uneyen, almost hilly; we at last came to waves of pure sand which were said to shift their position, like those in the African deserts, and we eagerly looked out for the moving heaps; but all

* "In the journey from the Oxus to Bokhára, the mean difference between the wet bulb and the temperature of the air was upwards of 20°, the extreme difference often 34° and 35°, and the least 10° or 11°, but in Calcutta during the same month (July) 3°. 5 is the mean difference, and 5°. 5 and 2° the maximum and minimum." At Benares, according to Prinsep, the difference between the wet and dry bulbs is sometimes 37° in the hot season. Bokhara seems to be drier in July than Calcutta is in January :—can July be the driest month at Bokhara, when the cold season appears to be driest in other parts of the world ?' If the cold weather is driest here in winter, the evaporation must be astonishing, which will account for the excessive degree of cold in so low a latitude as 39° 43'.

"The evaporation from a cup can be easily measured by a scale : I found it more than once amount to two inches, in 24 hours, the thermometer being from 72° to 104° in the open air ; in the shade, since entering Túrkistan, the highest has been 110°, and the lowest 54°, which occurred in the desert. In so arid an atmosphere you may suppose we do not complain of heat, although the thermometer is every day 97° and 98° in the house, and the more one perspires here the colder one becomes. It is owing to the hygrometrical state of the air, that we see ice made when the thermometer is above 50°, and by increasing the aridity, ice might be made at 70° : in fact a difference of 37° is nearly that in the driest months here, we ought therefore to expect ice with the thermometer at 80°. This great aridity will account for the state of our feelings, the formation of ice, preservation of meat, drying of fruits, cold, vegetation, and many other phenomena."

I could believe of such an occurrence, and which I saw, was the currents of loose sand raised from the surface by the wind, or blown from one place to another, the heaps themselves being immovable *en masse*. At Karshí, which the map places full half way, we were seized with fever, no doubt from the swamps of Balkh or the miasms of the Oxus. Burnes was first taken ill (some days previous), and here I and two of our party with a tea merchant followed, and as I delayed treating myself as doctors usually do, it was not until I had been a week in Bokhára, and after quantities of quinine, that I recovered, but the poor merchant died. He was an intelligent and agreeable companion, and the few days we were together in the desert left the impression of a long period of friendship. In our situation we become acquainted with individuals who, wiser in local experience than ourselves, entertain us by their adventures, and from whom we separate with regret. The fate of this man, out of so small a party and in so short a time, was a matter of some reflection to us, who were even more liable to the effects of climate and the fatigues of travelling ; it shewed us that without any dangers from robbers, tyrants, or intolerant bigots, our health was sufficiently precarious, to make such a journey of doubtful success ; and though the chances of adventure did not allow us to consider any thing a real hardship, yet on looking back, we saw ample reason to consider ourselves fortunate in having so well overcome the trials we were exposed to.

I had almost forgotten to mention that we paid a visit to the desolate grave of poor Moorcroft at Balkh. It was a bright moon-light night, and our Hají, who attended his remains to the earth, showed us the way to the spot, which lay amidst marshes, and I could not help thinking that these very marshes had caused the melancholy event. We were surprised to hear that the severities of fortune, which accompanied Moorcroft's career from the beginning, had pursued him even beyond the grave, and that a burial place was barely permitted to his remains, upon the skirts of the city and on the outside of a garden wall. The spot is retired, and had we not been guided to it, by one who had witnessed the interment, we might have searched or inquired in vain for the site. We were unprepared for such a spirit of odious prejudice as seems to have prevailed against this lamented individual, for the same feelings did not exist in regard to Mr. Trebeck. Mr. Guthrie's body is contiguous. Those solitary receptacles have for the first time been seen by an European eye, and remote as they are from friends or countrymen, they are nevertheless unmolested, where they themselves, while living, had gained by their praise-worthy conduct, a respect and remembrance that will long be cherished in Turkistán ; and if they encountered some tyrants and wretches in their long travels, they met with many friends and wellwishers, and have left the name of Englishman with all the honors which we most covet. At Karshí we had a specimen of the gardens which poets have celebrated in their descriptions of Samarkhand and Bokhára; we lay amidst apricots and ice, and I enjoyed both in spite of an ague that almost shook me to pieces. We heard of slaves for sale here, and a young Hindú of our party, a clever and promising lad from the Delhi institution, whose thirst for knowledge leads him into many strange situations, has the following dialogue in his journal about the traffic. It is headed " a trick or jest for a slave girl, " and I extract it literally.

" On my return from bazar I besought a man to shew me the house of the merchant who sells men and women, which I reached after traversing very hot streets. The merchant received me civilly, and sent for three women from a room adjoining to that which was his own. He told them to sit before me, and then inquired of me which I liked to buy. I replied to him, the young one, who had regular features, was mild and attractive, her stature elegant, though below the middle size, while her wit and vivacity exceeded even her allurements. In the mean time the two others, who were neither ugly nor beautiful, stood up and went into their rooms; the young one followed soon after, but sat in a separate place, guarded by a very old man. I was told by the merchant to go in the same room, to speak, to laugh, and to content the girl. I sat out to the girl, and conversed in the following manner. I love you and like to buy you, art contented and pleased with me? She smiles and says, No, I do not like you, because she is afraid perhaps I sell her to another after enjoying my own gratification: her name was *Gul-sad-barg*, (the flower of a hundred leaves.) After much altercation, she says, Very well, I should swear not to sell her again and make please to her master. The old man who sat by the door told her to stand and to show me her whole body according to the custom, which means perhaps that there be not any sort of disorder in her person. All her body was crystalline, her age was 13 or 14 years. I talked with her a long time on various subjects, inquiring her nativity and birth; she said her home was in Badakhshán, and she had a large family: she was ravished by the ruler of the country, and sold to this merchant. On saying this she brought a flood of tears in her eyes, and said, For God's sake buy soon, and release me from the hands of this unmerciful Uzbek. It made me very sorry: I cursed the ruler, and bestowed a malediction on her merchant who troubles her. I instantly got up and came away to my camp, without seeing or telling any word to the merchant, as I had not inclination to buy her. The experience and fun induced me to make a trick for investigating the principles of slave merchants, who I say are very miserable, criminal, savage, and unmerciful men indeed."

At this place a conspiracy was attempted to be formed against us by a Persian of our káfila, a man of consummate address and knavery, and rumours were afloat that the king of Bokhára had interdicted our entering his capital; but the extravagance of the plot almost betrayed its falsehood: however, considering the influence and conduct of the Názir, who was the bosom companion of the Persian, and with no other voucher of our character but our passports, we did not like the circumstances, though they scarcely made us uneasy. The remaining four marches to Bokhára had less of the desert in them ; the undulations continued; also sand and salt-water. Sometimes the true and unlimited horizon was spread before the eye; at last, on the 27th of June, we arrived in this fine city, which had a few months before appeared so remote and uncertain. I have written so much that you must not at present expect any account of this ancient place. The transit of letters from this is very uncertain, and to give them a chance of safety from the Allemáns (robbers), and even the Khybarís near Péshávar, we must fold them in the native fashion. The usages of the Muhammedan government are here extremely strict, and the precepts of their religion are fulfilled with awful rigor; we are not likely to come under any of the penalties, except, indeed, we are seen drunk in the streets, or smoking publicly, neither of which there is any chance of; but we might certainly have committed ourselves in regard to dress, which for all infidels is strictly defined and peremptorily imposed, and if we are naturally obnoxious to their sight, our dress adds to the spectacle. A black cap on our head and a rope round our waist, are particularly interesting; for we have only to pull the cap over our face and put the rope about our neck, to make us really a spectacle! We are allowed to reside in a private house after some little remonstrance; a public sérai is our proper dwelling place. We cannot ride within the walls of the city, and must push our way through the densely-peopled streets, which detracts considerably from our interest in the scenes of the bazar, and in our walks in an atmosphere so warm and dusty. Moorcroft was permitted to ride, but he was in character, and brought presents for the king and his courtiers; but this privilege was only granted on condition that his Muhammedan syces should accompany him mounted, as they could not be seen on foot attending an infidel on horseback. We have no character at all to support, except it is that of faqírs or beggars (not religious mendicants). The garments of all other unbelievers are similar to those in which we are accoutred, such as Hindús, Armenians, and Jews, and these last we especially resemble in every thing except their features. The restriction we feel most is being unable to write, but this is more our fault, or our courtesy, than any actual prohibition of the state, for as we can elude suspicion by writing at night, it is only the chance of detection that prevents us taking up our pen in the day time. As I cannot see well by lamp light I shall not attempt making a single note, and by the time we leave this I shall remember nothing to write about. I have seen the minister, Ghós Bégi, once: he is a curious old man, and very fond of decorum, though without state or show in himself. He is always finding fault with our dress or posture in sitting; and this last is no easy matter, although we have been trying it for six months past. With all the Bégi's shrewd penetration, he seems to be at a loss what to make of us.

Upon the whole, our reception at Bokhára, if not remarkable for distinction (except indeed that regarding our dress), or favors (neither of which we had the least claim to, and I at least had no expectations of), has been sufficiently respectable and civil; and with the people, whether in the crowded bazars, in public sérais, in private converse, or in the mosques, our name and country have been a recommendation instead of a pivot for insult and ignominy; and this too in a city notoriously orthodox in religious duties, and where Muhammedan principles of every kind are fearfully arbitrary. We have not heard the epithet of *káfir* from one end of our journey to the other, and only at one place, near Attok, some boys used the expression of monkeys. Wherever we have gone and appeared as Europeans, that character has been respected; and we may depend upon it, that the name of Englishman, whether this is understood by *Feringi* or *Angrez*, if assumed with discretion, is our best passport.

We have no chance of seeing the king, except in the open streets with the rest of the mob: the rascal of a Názir has played us this trick. Dost Muhammed's letter would have done us a service. The bazars here are splendid, and the police regulations admirable. Bokhára is a large and populous city, eight miles in circuit, and exceeding any we have met with in our journey. There are many fine colleges and other buildings; the Uzbeks are a handsome race, but the Jews, (more especially the Jewesses,) carry off the palm of beauty. There is more religion, more law and justice, and more crime, than in any place of equal size in Asia; but property and life are safer than in most cities in the world, whether civilized or savage. The people here are much more familiar with the Russians than with the English, and another Russian embassy is soon expected at Bokhára. People from all parts of the world except China are seen here. Every body drinks tea, generally after our fashion, but without milk; there is a kind of tea called *banka* which comes viâ Russia from China; it costs 10 rupees, and is very fine flavored, and it is said that a sea voyage injures it.

The *banka* tea goes from China to Russia by a direct road, avoiding Yarkúnd, as by being packed up in small canisters it will not bear export by the mountainous route, and by coming here from Orenburgh it thus attains a very high price; the tea trade is immense. We first saw loaf sugar at Khulm, and it is the same as we have at home. Many people in Bokhâra wear watches, all of London mechanism. In the Bazar we see tea urns with the red hot iron in the middle to keep the water warm, and many things remind us of Europe.

We have tried horse's flesh, and having beef at the same time, we gave the preference to the former; but whatever Elphinstone says about horse's flesh being the food of any part of the people, it is at least very rare, and beef is far from frequent.

The climate, that eternal subject, is warmer than is agreeable; in fact it is sultry, but dry, and otherwise delicious, the sun shining out his entire course, and not a cloud in the air. How very different from India at this season! The nights are generally cool, but we find sleeping in the air necessary for comfort; the usual range of the temperature outside is from 74° to 103°, rising to 106° in the streets: we loathe the air in a room heated to 96° and even 110°, and, although sitting quietly, we feel it rather disagreeable; but in so arid a climate, the sensation is less oppressive at this degree of temperature, than at 80° in India, at the same season. The most singular part of the climate is the intense cold of winter, which freezes such a stream as the Oxus. The blocks of solid ice in the bazars here indicate the severity of the weather, and can only be explained by the extreme dryness of the air.

There are disturbances at Urganj, and their army has marched to attack the Persians on the line of our route; we therefore know nothing of our prospects: but it strikes me we shall be forced to take the road to Meshid. Burnes and myself are now quite recovered. I have received no letters since the middle of March, and the only dawk which has reached us since crossing the Indus, we got at Khulm, and by it came Nos. 1 and 2 of the Journal of the Asiatic Society; it will please the Editor to know, that his work spreads itself over such distant regions. I have picked up some coins here, bearing Greek inscriptions and heads, and something like masonic insignia upon a small axe; but I am too distant here to venture to send the originals, though I may impressions."

*Bokhára,* 15*th July.*

## II.—*On the Manufacture of Saltpetre, as practised by the Natives of Tirhút. By* Mr. J. Stevenson, *Supt. H. C.'s Saltpetre Factories in Behar.*

The soil of Tirhoot almost every where contains a large proportion of saline matter, such as nitrate of potass (saltpetre), nitrate of lime, sulphate, and muriate of soda, &c.* but in general the sulphate of soda is most abundant. The saltpetre (as well as the other salts) lies in patches as it were, some parts being more productive than others, according as carbonate of lime and sand alternately predominate. By analyzing the different soils, I have found those places most productive of nitre to contain a redundancy of the former; and on the contrary, where the soil was unproductive, I found a redundancy of the latter substance. I am therefore naturally led to the conclusion, that carbonate of lime is one of the principal agents in the formation of this article. This will also account for the district of Tirhút being more productive of nitre than any other place in India, for almost half of its soil is calcareous; an average sample of it, collected from various places where saltpetre abounds, and carefully analyzed, gave me the composition as follows. 100 parts being operated upon.

| | | |
|---|---|---|
| Matter insoluble in the three mineral acids, | Silex, .............. | 50.0 |
| Matter soluble in ditto, ............. | Carbonate of Lime,.... | 44.3 |
| Matter soluble in water, .......... | Sulphate of Soda,...... | 2.7 |
| | Muriate of do......... | 1.4 |
| | Nitrate of Lime, ...... | 0.9 |
| | Nitrate of Potass,...... | 0.7 |
| | | 100.0 |

This analysis does not agree with Dr. John Davy's, but be it remembered, that scientific gentleman operated upon saltpetre earth from the factories, which of course contains more saline matter than the general soil.

In the month of November, the *loneahs* or native manufacturers of saltpetre commence their operations, by scraping the surface off from old mud heaps, mud buildings, waste grounds, &c. where the saltpetre has developed itself in a thin white efflorescence, resembling frost rind. This saline earth being collected at the factories, the operator first subjects it to the processes of solution and filtration. This is effected by

* I have not been able to ascertain whether the sajjí matí (native carbonate of soda) is found in this district; as far as my own observations have extended, it does not form a part of the composition of the soil. I also could not detect any alumina, though it is likely some parts may contain it.

a large mud filter, lined on the inside with stiff clay. It is a round hollow basin, in shape resembling the top of a well, from 6 to 8 inches in diameter. A false bottom is formed of pieces of bamboo, laid close, and resting upon pieces of brick. This leaves an empty space of a few inches above the solid bottom, for an outlet to the filtered liquor. Over these bambús, a covering of strong close wrought grass mats are laid, which complete this simple form of filter. The operation then proceeds with the process, by spreading over the mats a thin layer of vegetable ashes, generally from the indigo plant, upon which the earth to be subjected to the filtering process is laid, and trodden down level, and to the desired solidity, by the operator's feet. This requires great attention on the part of the man who performs it: for if too solid, the water will pass through too slow; on the contrary, if too soft, the water will pass through too quick; for the solution of the saline matter to take place, and the full products would not be obtained. After this point has been adjusted, water is poured gently upon the earth to the depth of four or five inches, according to the size of the filter and quantity of earth used, (one of six feet diameter will filter 20 maunds of earth.) The whole is then suffered to remain tranquil for several hours, during which time the water gradually passes through the earth, dissolving the saline matter in its passage, and filtering through the mats, drops into the empty space between the solid and false bottoms, and is conveyed by means of a spout of bambú, or a hollow tile, into an earthen receiver, made large enough to hold the full quantity of filtered liquor, and half sunk in the ground for the purpose.

The saltpetre liquor thus obtained is more or less coloured with oxide of iron and decomposed vegetable matter. Its specific gravity also varies with the quality of the earth operated upon. An average from a great number of filters gave me 1.120.

The second process is to evaporate the saltpetre liquor to a crystallizing state, which is effected in earthen pots fixed in two rows, over an oblong cavity dug in the ground, the interstices between the post being filled up with clay. An aperture at one end of the cavity serves for an egress to the smoke; another at the opposite end is used for the introduction of fuel, which is generally dry fallen leaves gathered from the *ám topes* (mango groves): such are the simple materials used in this part of the manufacture. The boiling is continued till the liquor is evaporated to the crystallizing point, which is ascertained by the operator taking from time to time a small portion of the liquor from the pots, and setting it aside to cool in small earthen dishes, like a common saucer. After the liquor has cooled, and the crystals formed agreeable to the practice of the operator, the fire is stayed, and the liquor removed to large shallow earthen dishes (which are used instead of crystallizing coolers), placed in rows, and sunk to the brim in soft earth. At the end of about 30 hours, the process of crystallization is finished. The crystals of saltpetre are taken out of the coolers, and put into baskets to drain, after which they are removed to the store-house, ready for sale.

During the operation of boiling, it occasionally happens that too much heat has been used, and the pots are in danger of boiling over. To prevent this, the operator has a very simple remedy, which our more scientific operators might not be ashamed to take a lesson from—a bunch of dry jungle grass is fixed at a right angle, to the end of a stick; this is dipped into the liquor, and held up over the pot, and the liquor, which it had absorbed, falls down in a shower (cooled by the air) into the vessel it had been taken from. The temperature being thus reduced, the evaporation proceeds more steadily, and the accidental boiling over is prevented. The mother liquor, remaining after the crystals of saltpetre have been removed, is returned to the evaporating pots, and mixed with a fresh portion of the liquor from the filters, for a second boiling, and crystallization. The extraneous salts, such as sulphate and muriate of soda, which the filtered liquor from the earth always contains, are partly found at the bottom of the pots, (the muriate of soda in particular,) and partly in the mother liquor, remaining after the process of crystallization. But to separate them more effectually, the manufacturer passes the liquor from the boilers through a piece of coarse cloth, placed in a basket; and when the liquor has drained through, the greater part of the extraneous salts are found on the cloth. To do this effectually, it is necessary, that the liquor should be at the boiling point, otherwise the saltpetre liquor would not leave the sulphates and muriates, but would form an anhydrous mass.

The muriate of soda, or common salt, is rendered more pure by a subsequent boiling. It is then called by the natives *pakwa nimak*, and is sold in the bazars as an article for culinary purposes. The remaining extraneous salts—sulphate of soda, nitrate of lime, &c. are returned to the earth, to undergo a change by decomposition against another season. The *nitrate* of *lime* is decomposed by the *carbonate* of potass, which the vegetable ashes, used in the process, contain. When solutions of these salts come in contact with each other, a mutual decomposition takes place. The *nitric acid* of the lime combines with the potass, and the *carbonic acid* of the *potass* combines with the lime. Thus two new salts are formed, viz. *nitrate* of *potass* (saltpetre), and *carbonate* of *lime*. In this manner, the old earth, which has already produced saltpetre, is regenerated, and rendered productive against other seasons. The native manufacturers are aware of this fact, but not being able to account for it on scientific principles, they say, that *saltpetre generates or developes saltpetre*; but I dare say that most scientific men will concur with me, that the above idea of the natives is next to a physical impossibility. Owing to the porous nature of the earthen crystallizing vessels, a part of the saltpetre liquor oozes through the bottom, and is absorbed by the earth on which the utensils are placed, occasionally they are broken, and the contents of course falls into the earth below. This earth is again subjected to the process of filtration, and the practice of the manufacturer, in order to obtain what had been wasted in the above manner. Thus the *loneahs* proceed from season to season, without the least deviation or alteration in their manufacture. No persuasion, however reasonable, by way of improvement, will cause them to alter the plans which their forefathers had in practice; and it is probable, that the methods used at present were the same three thousand years ago.

The saltpetre obtained in the above manner, which I have attempted to describe, is a very impure article, termed by the natives *dhoah,* and is sold at the rate of from two to three rupees a maund. It generally contains from 45 to 70 per cent. of pure nitre. The following analysis was tried from an average of several hundred maunds of what was stated to be of good quality, and brought three rupees eight annas per maund. 100 grains operated upon.

| | |
|---|---|
| Insoluble matter, sand, and mud, | 5.0 |
| Sulphate of soda, | 9.1 |
| Muriate of do. | 8.0 |
| Total impurity, | 22.1 |
| Nitre, | 77.9 |
| | 100.0 |

This may be taken as a fair sample of the quality that the *loneahs* produce in general, but when it passes from their hands to the saltpetre merchants, it is frequently adulterated with sand, mud, and dirty salts of various kinds, to such a degree, that it scarcely contains 50 per cent. of pure nitre. A sample of this adulterated article from 15,000 maunds gave me the following result:

| | |
|---|---|
| Insoluble matter, sand, and mud, | 22.7 |
| Sulphate of soda, | 23.8 |
| Muriate of do. | 4.2 |
| Total impurity, | 50.7 |
| Nitre, | 49.3 |
| | 100.0 |

To produce the article called by the natives *kalmee* (crystallized in long prisms, meaning the best kind of saltpetre), the *dhoah* is re-dissolved and crystallized; the percentage of nitre will then amount from 85 to 95, pure; but this is only done by the opulent native merchants who supply the Calcutta bazar.

In conclusion, I have only to observe, that the above methods of manufacturing saltpetre, used by the natives of this country, although rude, yet are very simple, and more effective than most of our scientific chemists, at first sight, would suppose. No manufacture in Europe can equal it in point of cheapness and simplicity; and when it is considered, that these simple people have no knowledge whatever of chemistry as a science, it is surprising how well they manage to make the rough article. At least, such were the ideas that struck me during the many hours (and I may add pleasant ones) that I have spent in observing the simple, but not altogether ineffective, plans and operations of this industrious manufacturing people.

The above notices claim no merit, except that of truth. They are the result of observations and notes taken on the spot, during a residence of two years in the district of Tirhút; province of Behar.

*Tirhút, 7th December,* 1832.

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## IV.—*On the Greek Coins in the Cabinet of the Asiatic Society.* *By* James Prinsep, *Secretary.*

Having in the first volume of the JOURNAL described the Roman Coins of the Society's Cabinet, with such explanations as might, I hoped, be of use to those who were untutored in the mysteries of numismatology, so that, by the aid of the drawings, they might be able to recognize the type of Roman fabrication in any antique specimens which they were likely to discover on the continent of India, I now propose to follow up the subject, as promised in my former paper, by extending my examination of the Society's Cabinet, through their series of Greek and Persian coins, (leaving the Indian Coins for a future occasion;) and I believe that although the specimens of the two first are far from being numerous in our collection, still the drawings of them will be found sufficient to furnish tolerable guides for the assistance of the student in discriminating the coins of these countries at different periods of their history.

I cannot say how many out of the whole have been found in India itself; many on the contrary appear to have been brought from Persia.

Both Grecian and Persian coins however are met with frequently in India, and it is very easy to know them when once their forms have been presented to the eye. Several were brought by Col. Wilson from Persia, who kindly permitted me to take drawings of them; Lieut. Conolly obtained a few in his overland journey to India: and Lieut. Burnes has favored me with one or two specimens of a number of coins collected by him in Ancient Bactria, a country but recently opened to the investigation of the antiquarian.

It is from this unexplored part of Asia that we may confidently expect a multitude of Grecian antiquities gradually to be developed. Travellers of all nations are already flocking thither to trace the steps and discover the monuments of Alexander's Indian conquests. The most successful in this interesting line of research, partly from the advantage of his rank in Maha-raja Ranjit Singh's service, has been General Ventura, who, imitating Belzoni at the Pyramids of Egypt, instead of conjecturing and speculating upon the origin of the celebrated *Tope* or mound of *Manikyala* in the *Punjab*, set boldly to work in 1830 to pierce into its solid mass by digging. He was rewarded by the discovery of numerous coins and other relics which had lain untouched for perhaps twenty centuries*. A Russian antiquary I understand had previously amassed a vast collection of Greek coins in the same country. But it is by no means in the Punjab alone that we are to look for antiquarian riches: the north-western provinces of India offer as large a field of enquiry—and if the coins of Kanouj and Oudh are less interesting from the nature of the characters in which their legends are graven being wholly unknown, they should nevertheless be regarded as more curious because they speak this unknown language and remain the only records of kingdoms and revolutions whose existence is but faintly discernible on the page of history.

It is principally to instigate those who have opportunities of forming collections in the upper provinces, that I have drawn up these notes, and I cannot adduce a more powerful motive for studying and searching, than the example and success of that indefatigable investigator of history and antiquity, Major Tod, who thus describes his method of forming a collection in the 1st vol. of the Trans. Roy. As. Soc.

"For the last twelve years of my residence in India, (amongst Mahrattas and Rajputs,) the collecting of coins as an auxiliary to histo-

* An account of General Ventura's operations was communicated to Col. James Young and by him printed in the newspapers of the day: it is reprinted in the seventeenth volume of the Researches, page 600.

ry was one of my pursuits: and in the rainy season I had a person employed at *Mathurá* and other old cities to collect all that were brought to light by the action of the water while tearing up old foundations, and levelling mouldering walls.

In this manner I accumulated about 20,000 coins of all denominations; among which there may be not above one hundred calculated to excite interest, and perhaps not above one-third of that number to be considered of value: but among them there is an Apollodotus and a Menander, besides some rare medals of a Parthian dynasty, probably yet unknown to history."

The coins of Greece are divided by numismatologists into two principal series: the civic, and the monarchical. The former comprehends all the moneys of the different states of Ancient Greece, bearing the names of their cities and people, and the symbols and devices emblematical of them, or the figures of the tutelary deities under whose especial protection they considered themselves placed. The monarchical series begins with the Macedonian dynasty, or about 500 years before Christ, continuing throughout the kings of Macedon, and, after the division of Alexander's empire among his generals and successors, subdividing itself into the several branches of the Seleucian or Syrian, the Egyptian, the Bactrian, the Parthian and Armenian dynasties; besides, which may be enumerated the Pontine kings and several of minor importance.

The civic coins, of which the Hunterian Cabinet at Glasgow contains so magnificent a collection, are generally supposed to be more ancient than the monarchical series; they are mostly of ruder fabrication, but the figures of animals and gods are sometimes executed with great skill: the period of the highest proficiency in the arts is, however, universally acknowledged to be the age of Alexander, or the third century before Christ: the coins of this distant age, even the meagre and scattered specimens which we have picked up in India, are so exquisitely finished as to furnish models to artists and sculptors of the present day, while they almost defy their best powers of imitation.

The inscriptions found upon the earlier coins are generally the rude initials of the names of cities or people, becoming more complete as we descend in the series: the names of chiefs or principal men and priests are introduced sometimes at a later period, but as no dates are given it is impossible to assign any exact age to most of the civic coinage. Throughout the Macedonian series the names of princes are introduced, and history affords chronological data for their classification. The inscriptions are generally written in straight and parallel lines, differing in this respect from the legends of Roman coins which are peripheral, as are those of the imperial Greek coins, which are merely translations of the latter.

It has been urged that the Greek coins although inferior to the Roman, because they afford no record of important events or of dates to assist in the elucidation of history, yet have an intrinsic value of their own, from the service they have rendered to Geography in preserving and exhibiting the names of a multitude of cities and colonies, and by the frequency of their occurrence, or by their superior workmanship, throwing light upon the relative importance of states. Other local peculiarities are marked by the devices they bear, the origin of many of which is easily traced in the history or mythology of this classical nation : thus, the emblem on almost all the coins of Athens is an owl, the bird of Minerva: for Corinth, we have, according to Pinkerton, the winged horse: a wolf's head for Argos; a bull's head for Bœotia; a minatour's head and the labyrinth for Crete; a horse's head for Pharsalia; a lion for Marseilles; a tortoise for Peloponnesus; a sphinx for Scio; three legs joined for Sicily; a horse for Thessaly; a crescent for Byzantium, the origin of which deserves mention from its having since become the badge of Mohammedanism. When Philip of Macedon besieged the place, and was going to storm it in a cloudy night, the moon shone out and discovered his approach, so that the inhabitants observed and repulsed him. The Turks upon entering Constantinople found this ancient badge in many places, and *suspecting some magical power in it*, assumed the symbol and its power to themselves*.

The general demonination of the silver money among the Greeks was the *drachma*, or eighth part of an ounce, which according to Pinkerton was about ninepence, or a penny more in value than the *denarius*: from the *drachma* were derived the half, double, and quadruple, or *hemi drachma*, *didrachma*, *tetradrachma*, &c. The smallest silver coin was the *obolos*, but that was also, and generally, a copper piece.

After these few introductory remarks I will proceed to notice the coins in our possession, beginning with those of the

### *Greek Cities.*

Plate I. Fig. 1. A silver coin in the Society's Cabinet.

*Obverse.* A lion walking with head erect. Double triangular symbol ✡ and stars,

*Reverse.* Jupiter sitting. Legend illegible; *tetradrachma*: weight 250 grs.

* Pinkerton, i. 241.

The lion occurs but seldom on the coins of Greek towns in the Hunterian collection, and no where with the obverse of Jupiter. It is found on the coins of Messana in Sicily, and Velia in Italy (ΥΕΛΗΤΩΝ); also in some of Smyrna but by the figure of Jupiter it is more probable that this coin belongs to the Alexandrine series.

*Fig.* 2.—A silver coin, brought from Persia, by Col. Wilson.

*Obverse.* Head of Minerva with helmet, facing the right.

*Reverse.* Pegasus flying towards the right.

It is impossible to say, for want of letters or signs, to what town this coin belongs. Many used the same devices, as Leucas, Cleone, (Hunter 100,) Corinth, &c.

*Fig.* 3.—A silver coin, belonging to Col. Wilson.

*Obverse.* Man astride upon a dolphin.

*Reverse.* Man riding on a horse.

This device is very common indeed on the coins of Taras, or Tarentum, in Italy, (Hunter 305.)

*Fig.* 7.—A small copper coin, purchased from an Armenian in Calcutta, bearing on one side a handsome head of the city, with a turret-crown. On the reverse—a Griffin, with something in her mouth. Above—the inscription is of three lines, of which the letters L C Λ . . .

ΑΝΓ ΤΙΟΧΟ

ΗΤΕ

are visible. It may probably be of Antioch, in Syria.

*Macedonian Coins.*

*Fig.* 4.—A silver *drachma* of Alexander the Great. (As. Soc.) wt. 62 grains.

*Obverse.* Head of Hercules, beardless, covered with a lion's skin, coming under the ear like a horn.

*Reverse.* Jupiter seated, holding an eagle in the right hand: a staff in the left, along the left side ΑΛΕΞΑΝΔΡΟΥ, and below Α Σ Ι Λ Ε Ω. (βασιλεως).

*Fig.* 5.—Another, similar, but of half of the size, *hemidrachma.*

Another, *tetradrachma,* (220 grs.,) of similar device. As. Soc.

*Fig.* 10.—Another, legend illegible. Ditto.

The head of Alexander himself occurs very rarely on the coins of his reign:— they are known by the ram's horn on his forehead introduced as a mark of his discent from Jupiter Ammon: the ram's horn is quite different from the lappet of the lion's skin in the present specimens, which might at first mislead the student.

*Fig.* 8. *Obverse.*—Head of Hercules in the lion's skin.

*Reverse.* A club, with the inscription ΛΕΥΚΑΔΙΩΝ ΤΙΜΟΘΕΟΣ.

*Fig.* 9.—Another coin, of the same device, with ΛΕΥΚΑΔΙΩΝ ΛΑΜΥΛΟΣ. Both in possession of Col. T. Wilson.

These two coins were struck at Leucas, a town near the celebrated promontory of the same name in Acarnania, whence Sappho precipitated herself into the sea. The Hunterian Cabinet contains a multitude of coins of this place, but none with these names of Timotheos and Lamulos, or Damulos.

*Syrian Coins. (Fig. 11.)*

Next to the Alexandrine series, in point of time, and of merit, rank the coins of the princes of Syria, the descendants of Seleucus Nicator, who, upon the partition of Asia among the officers of Alexander, took possession of Syria, and subjected to his sway all the provinces up to the Indus. Of the Seleucidæ kings, I lately obtained one silver coin from a Babylonian Jew; it is represented in Fig. 11, and is in beautiful preservation; the head, in high relief, and of exquisite workmanship, wears the fillet or diadem, which belonged exclusively to royalty, and was not even assumed by the Roman emperors, until the reign of Diocletian. On the *reverse*, is a sitting figure of Ceres, with a cornucopia in her left hand, and a sceptre (or torch?) in her right, She sits on an ornamental chair, the leg of which is formed of a winged Cupid with a Dolphin tail. Beneath is a symbol compounded of the letters A and T which is supposed to stand for Antioch. The inscription is distinct ΒΑΣΙΛΛΕΩΣ ΔΗΜΗΤΡΙΟΥ ΦΙΛΑΔΕΛΦΟΥ ΝΙΚΑΤΟΡΟΣ, which refers to Demetrius II. Nicator, who reigned 145 years before Christ. It is a *tetradrachma*.

*Fig.* 6.—A small silver *drachma* in the Society's cabinet. Head, in good relief, with simple band.

B. C. 292. Jupiter seated on a solid altar, holding thunderbolt, or priest sitting on the veiled stool. Down the sides ΒΑΣΙΛΕΟΣ ΔΗΜΗΤΡΙΟΥ.

This coin of Demetrius is recognized to be Seleucidan, from the figure of Apollo sitting upon a peculiar altar described by Pinkerton as "a hamper inverted. Some think this seat is that upon which the priest of Appollo at Daphne, near Antioch, used to sit to return oracles. It was placed over an aperture of the floor of the temple through which the gale of inspiration was thought to raise." A Demetrius occurs in the Macedonian series—and also among the Bactrian princes.

*Egyptian Series.*

The coins of the Ptolemæan dynasty equal, in beauty and interest, the others of Macedonian origin: the silver pieces are very numerous, the brass and copper pieces exceed in dimensions all other antiques: they weigh about two ounces. The Eagle almost always appears as the reverse of the Egyptian kings; the date of the reign is also marked on the silver in Greek numerals preceded by L or λυκαβαντος.

Pl. V

# GREEK COINS.


J Prinsep del et sculp

All of the silver specimens in our possession seem to belong to the same Ptolemy, from the marked physiognomy and projecting chin.

*Fig.* 12.—A silver *tetradrachma,* brought from Egypt by Mr. Drew.

*Obverse.* Head, with curly hair, bound with a diadem.

*Reverse.* The Eagle of Jupiter standing on a thunderbolt, with the inscription ΠΤΟΛΕΜΑΙΟΥ ΒΑΣΙΛΕΩΣ ΠΑ L I H (anno 18).

A coin of Ptolemy the First of Egypt, or it may be of Ptolemy the Fifth, B. C. 204, as Pinkerton says his coins have mostly the letters ΠΑ or ΣΑ, explained to signify Paphos or Salamis, both cities of Cyprus, which island was part of the Egyptian monarchy. The weight of all these coins is about 212 grs. ;

| | | | | | |
|---|---|---|---|---|---|
| *Another.* | Same device | L H or | Anno 8 | belong- | J. P. |
| *Another.* | Ditto | L I Γ | Anno 13 | ing to | J. P. |
| *Another.* | Ditto | L I Δ | Anno 14 | | J. P. |
| *Another.* | Ditto | L I Δ | Anno 14 | | As. Soc. |
| *Another.* | Ditto | L I E | Anno 15 | | ,, |
| *Another.* | Ditto | L I Z | Anno 17 | | ,, |
| *Another.* | Ditto | L I L | Anno 17 | | ,, |
| *Another.* | Ditto | L I H | Anno 18 | | ,, |

A large copper coin of one of the elder Ptolemies, bearing ΠΤΟΛΕ ΜΑΙΟΥ ΒΑΣΙΛ ΕΩΣ. Same head and eagle. The copper coins seldom had any date. Weight 740 grs. J. P.

After the subjection of Egypt as a Roman province, the Emperor's head always appears on the obverse; the eagle remaining still the most common device on the reverse. Fig. 14 is a drawing of the reverse of two coins of Nero in my possession: the legend is ΑΥΤΟΚΡΑ (for *αυτοκρατορος imperatoris)* with the date L I A (anno 11.)

*Fig.* 16.—Is the reverse of a Greek coin under the Roman Emperor Trajanus Decius, (A. D. 250.) It represents the metropolis of the Samosasan colony, as Cybele, with her turretted crown sitting on a cliff overhanging the ocean; in her hands are an eagle and a spike of corn, at her feet a horse, and around her the legend ΦΛ CAMOCATEΩN MHT KOM *Flaviorum Samosatensium metropolis Commagenes.* On the obverse around the head of the emperor is the inscription ΑΥΤΟΚΡ..ΤΡΑΙΑΝΟC CEB.

According to Pliny *Samosasa* was a town of Commagenes on the Euphrates. It was called *Flavia* when taken by Cœsennius Pœtus and Vespasian. The coin is noticed in Baudurius' work on the medals of the Emperors. The Society procured it from an Armenian, with other Roman coins, and I have here introduced it as a better example of the Grecian colonial coinage than that of Prusa in my former plate.

*Parthian or Arsakian Coins.*

The Parthian monarchy was erected by Arsaces, who filled the office of satrap in Bactria, in the year 256 B. C.. He had opposed the designs of Theodotus, who had first revolted from the third Syro-Macedonian monarch, and had raised the Bactrian provinces into an independent kingdom. Being unsuccessful, he fled to Parthia, where he expelled the governor, and declared himself independent. Vaillant, the numismatologist, has written a copious history of this powerful dynasty ; and has endeavoured to classify the coins of the 29 Arsacidæ kings : but it is generally acknowledged that there is too much of the fanciful in his appropriations, and most antiquarians have given up the attempt. The greater number of the Parthian coins have the same name, ΑΡΣΑΚΟΥ, with different epithets,—king of kings, the great, beneficent, lover of the Greeks, &c. : the heads however, are very distinct and numerous.

The most rational mode of arrangement is, to place those which are best executed first, (for Greek workmen were doubtless then employed.) And, as the execution falls off, and the Greek characters become obscure, we may suppose the dynasty to progress towards its absorption into the Persian empire, in the reign of Alexander Severus. A. D. 226. There is a remarkable distinction in the head-dress of these princes ; beginning with the simple band or diadem of the Greek monarchy, it gradually changes into a deep turban, and at length becomes a high-mitred cap, like that of the Persian monarchs.

We have two specimens of the larger silver Arsakian coins, and several of the smaller ones : the latter, upon which the characters begin to deteriorate rapidly, I have placed in Plate II. with the Persian coins.

*Fig.* 13.—One of two silver tetradrachms in the Society's collection.

*Obverse.* Head of Arsaces I. (dubious) facing the right ; with broad diadem and straight hair.

*Reverse.* Victory offering a crown to the king, seated, with the legend ΒΑCΙΛΕΩC ΒΑCΙΛΕΩΝ ΕΥΕΡΓΕΤΟΥ ΔΙΚΑΙΟΥ ΕΠΙΦΑΝΟΥ ΦΙΛΕΛΛΗΝΟΥ ; the third word ΑΡCΑΚΟΥ is probably excluded by the die being two large for the coin.

Before passing to the rest of the Arsakian coins, I would here introduce

*Fig.* 15.—One of three copper coins belonging to the As. Soc. They bear on the obverse, a well-executed head, bearded, and wearing a high-mitred cap. The characters and device on the reverse of two of them are nearly obliterated, but sufficient remains to shew the portrait of a female, (probably the wife of the king.) On the third, which forms the subject of the engraving, some of the letters are distinct, and appear to read ΣΟΦΙΑ or ΟΦΙΛ (quasi θεοφιλος), and on the left hand are some illegible characters, (Phœnician ?) differing in each.

Below the portrait are the three Greek numerals VΝΔ or ΥΝΔ (anno 454,) but of what æra, I am at a loss to conjecture ; it may be of the Arsakian or Armenian, but I must leave the point to those better versed in the subject.

To continue the *Arsakian* coins :—

*Fig.* 1. *Obverse.*—Head with wart on the forehead: hair dressed in rows of curls: plain band, with fillets hanging behind: an eagle apparently with a wreath in its mouth.

*Reverse.* Figure seated, holding out a bow over the characters [-+ around ΒΑΣΙΛΕΟΣ ΒΑΣΙΛΕΩΝ ΑΡCΑΚΟΥ ΕΥΕΡΓΕΤ ΔΙΚΑΙ ΕΠΙΦΑΝΟ ΦΙΛΕΛΛΗ.

Colonel Wilson had four coins with the same symbol, which Vaillant attributes to Arsaces Vonones XVIII. The eagle may also denote Chosroes ( Vail. ii. 195.)

*Fig.* 5.—*Obverse.* Head of peculiar features, with pointed beard and hooked nose.

*Reverse.* Sitting figure in trowsers, with bow, very rudely executed and the legend ΒΑCΙΛΕΟΣ ΑΡCΑΚΟΥ ΕΠΙΦΑΝΟΥΣ ΦΙΛΕΛΛΗ

Colenel Wilson has one similar, and both correspond with one in Vaillant, marked Arsaces Mithridates II. (V. i. 69.)

*Fig.* 6. Head with plain turban and bow behind: same inscription on the reverse, very rudely cut.

*Fig.* 2. Head with mitred cap, and arched nose, well executed: type, same as fig. 1, ΒΑΣΙΛΕΩΣ ΜΕΓΑΛΟΥ ΑΡΣΑΚΟΥ ΘΕΟΠ ΑΤΡΟΣ ΝΙΚΑΤΟΡ*os*, of better execution than either of the foregoing.

Vaillant ascribes the mitred cap to Arsaces Orodes. Col. Wilson had another coin of similar character.

*Another.* Mitred head similar to fig. 2, but without the hook ornaments: same type, ΒΑΣΙΛΕΩΣ ΒΑΣΙΛΕΩΝ ΑΡΣΑΚΟΥ ΔΙΚΑΙΟΥ ΕΥΕΡΓΕΤΟΥ ΦΙΛΕΛΛΗΝΟΥ.

*Fig.* 8.—Head with mitred cap, as in fig. 2, with a peculiar symbol behind it: same reverse.

Colonel Wilson has another similar to this in head-dress, it is ascribed to Arsaces Orodes (Vail. i. 145.)

*Fig.* 7.—Head with deep turban and mitred cap about it, and bow behind, with fillets of rudest fabrication: character quite perverted.

*Another.* Plain head-dress and device very rude, ΒΑΙΙΑΓΓΣ ΟΑΙΙΑΓΑΝ ΑΙΙVΝΟ ΓVΙΙΓΝ ΑΙΧΑΙΟV ..ΧΑΝΟVC.

In this the knowledge of the Greek letters seems very fast declining, and it is almost impossible to recognize the inscription to be identical with that of fig. 11.

*Another.* The same, but more legible; under the bow of all these there is a kind of altar formed like the letter Ā

The average weight of the above Arsacidæ drachmæ is 60 grs.

Besides the devices given above, Col. Wilson had one head similar to fig. 1, with the symbols of the sun and the moon, and a star (fig. 4,) referred by Vaillant to Arsâces Artabanus (I. 221), and another with two small *victories*, holding wreaths over the head (fig. 3), which is not found in Vaillant.

*Sassanian Coins.*

The Sassanian monarchy in Persia commenced with the year 223, A. D. when Artaxerxes overturned the Parthian dynasty. It continued until itself overturned by the Mahomedan caliphs in the year A. D. 636. No mode of adjusting the numismatology of this period can be attempted until we are able to read the ancient *Pehlevi* characters in which their legends are expressed. Perhaps if a considerable collection of these coins was made (and they seem to be very common in Persia), some key might be discovered to the value of the alphabet, for the titles will be alike in all, and the names are known from history. It seems a great reflection upon the art, that the coinage of the celebrated Noushirvan should not be known even to his countrymen.

*Fig.* 9.—A silver coin in the cabinet of the As. Soc.

*Obverse.* The head of the king facing the left, with curly beard, and a large tuft of curly hair: a peculiar crown or cap with two feathers behind: around it a legend in Pehlevi characters, very distinct, but the purport unknown: it is given more clearly in A.

*Reverse.* A fire altar *(mithras)*, with two priests or defenders, bearing swords or sceptres.

Another coin, similar, and inscription partly identical. (B)

*Fig.* 10.—Another similar coin. In lieu of the sacred fire on the altar is substituted the head of a king: little of the legend is visible.

In Colonel Wilson's collection are one or two more of a similar character, but the fire is the most common symbol: the legend on one of his (C) differs from the two above given in part, but one word is evidently the same, so that probably that word and the one which precedes it in A and B are all common titles of the ruling monarch, as "King of Kings," &c. (the Pehlevi reads like the Persian from the right to the left hand.)

*Fig.* 12.—A crescent head-dress of this form occurs in one of Col. Wilson's coins, in other respects similar to the rest; also upon another coin the emblems represented in fig. 31, as variations of the priest's wand or sceptre.

*Fig.* 14.—(of Col. Wilson's series,) has characters which might be mistaken for Arabic, also emblems of the moon, stars, and the sacred fire.

*Fig.* 15.—A small gold coin, of very rude fabrication, brought by Lieutenant Conolly, from Khorassan: the head has a crescented cap, and the commencement of the second part of the inscription agrees with that of figs. A and B.

*Reverse.* The fire-altar, and priests rudely executed.

This coin was noticed in the GLEANINGS, vol. iii. 295.

*Bactrian Coins.*

In the reign of Antiochus II. the third of the Seleucidæ, Theodotus, the governor of Bactria, revolted and established an independent monarchy. His capital was the modern Balkh, and his extensive kingdom included parts of modern Kábul, Khorasan, and Bokhára. It is remarked by Major Tod as singular, that, although the Arsacidan money is so plentiful, antiquarians have seldom met with those of the Bactrian princes, and indeed the names of only nine of them have been rescued from obscurity. So little was before known, that Major Tod himself may be said to have commenced the development of this new branch of numismatology, and in a worthy manner,—by adding two new medals discovered in India to the only two hitherto known;—one of Apollodotus, found in the site of an old town, *Súrapura,* between Agra and Etaweh; the other of Menander from *Math'ra**. This example has instigated others to the search, and a number of Bactrian or Indo-Scythian coins are now coming to light in the upper provinces. I have before alluded to General Ventura's discoveries; and to those of Messrs. Burnes and Gerard, in their route through ancient Bactriana; ~~Col~~. Swiney of Kurnál has also been successful in collecting and examining, and we may therefore soon hope to have the subject thoroughly elucidated. Such coins as were in the Society's cabinet, I have already depicted in the seventeenth volume of the Researches, to illustrate the learned remarks of Mr. Wilson, which should be perused by those who are now eager to pro-

* Trans. Roy. As. Soc. i. 314.

secute the inquiry. I have introduced into the present plate a few of the same figures, with a view to shew the general appearance of these curious coins.

*Fig.* 17.—Is taken from a cast made from the sealing wax impression of a gold coin found at Manikyala by Gen. Ventura.

*Obverse.* A standing figure with right-arm outstretched, and a kind of glory round the head: letters not decypherable.

*Reverse.* Figure of a warrior holding a spear in the right-hand, and apparently (from comparison with more perfect specimens of a similar coin) presenting an offering on an altar: the name illegible.

*Fig.* 18.—Is a drawing made in a similar manner from another of the Manikyala gold coins.

*Obverse.* The Persian head-dress and flowing hair are here apparent, but on the *reverse* the seated prince has rather the Indian costume. The characters on both sides are quite distinct, and have some similarity to Greek, but they have not been yet interpreted. There is a curious symbol upon all this class of coins, resembling a grid-iron or key, with sometimes three sometimes four prongs.

Messrs. Reinaud and Saint Martin of Paris *(Journal Asiatique* 1831*)* read part of the inscription on the *obverse* NANOBAΘOΥ .... PKIKOΥ, and on the *reverse* MANAOBA .... ΓO but nothing is gained therefrom. They ascribe the coin to Greek or Asiatic Princes who inherited the authority of Alexander's successors in the countries watered by the Indus.

*Fig.* 19.—A small copper coin, sent to me in a letter by Dr. Gerard, from the neighbourhood of Manikyala.

*Obverse.* The head of a king, with a kind of glory.

*Reverse.* An Equestrian figure, with the flowing ribbons of the Persian diadem: the characters are here decidedly Greek, and appear to form the usual title of *βασιλεως βασιλεων.*

*Fig.* 20.—Is a copper coin resembling the last, procured by myself at Benares.

The greater portion of the coins found at *Manikyala* are stated by Lieut. Burnes, to whom a copy of the plates of Mr. Wilson's Essay was sent by dâk, to have figures of a *Raja* dressed in a tunic sacrificing on an altar, on the *obverse;* and a figure standing by a bull on the *reverse* (As. Res. xvii. pl. ii. figs. 26 to 30): others are found with the impress of an elephant, and a kind of dagger (a female figure?) But as the inscriptions on these are rather Indian than Greek I have not included them in the present collection, and beg to refer the reader to the Asiatic Researches and to Col. Tod's Essay.

## *Muhammedan Coinage of Persia.*

To complete the sketch of Persian coins, it seems necessary to offer a few brief remarks on thc coinage of the Muhammedan powers which sucseeded the Sassanian dynasty,

At the period of the promulgation of the religion of Muhammed, the money of the lower Roman empire was current in all the neighbouring countries, and it was not until the *Khalifat* of *Abd-ul-malek*, in the year of the *Hejra* 76 (A. D. 695), according to Marsden, that a distinct coinage was instituted with a view of superseding the currency of Greek, or Byzantine, and Persian, gold and silver.

The circumstances that led to this event are thus detailed by the Arabian writers.—"The Khalif having adhered to the practice of commencing his epistles, addressed to the Greek Emperor, with the Mussulman formulary sentence, declaring the unity of the Godhead, and the ministry of the prophet; the Christian monarch took offence at what appeared to him an insult, and threatened that if it were persisted in, he should retaliate by introducing into the inscriptions on his coinage, with a view to its being circulated throughout the dominions of the former, words not likely to be acceptable to the professors of Islamism*." This impolitic contention produced the effect that might have been expected, and *Abd-ul-malek* determined to be beforehand with him in blazoning the creed of the faithful upon a new coin of his own fabrication, and he procured the ablest artisans from Damascus to cut the dies. Many of the first Muhammedans were however scandalized at allowing the sacred name of God to be profaned by the contact of impure hands.

The names of the Arabic pieces of money are uniformly inserted in their marginal legend, and are all taken from the coins of the lower Roman empire. Thus the copper piece was called فلس *felus* from *follis*; the silver درهم *dirhem*, from *drachma*, and the gold coin دينار *dinar*, from denarius, which though properly a silver coin, was used generally to denote coins of other metals, as the *denarius æris* and the *denarius auri*, or *aureus*.

The Society's cabinet does not possess any of the early Muhammedan coins; but one brought by Lieut. Conolly from Persia (fig. 16, Pl. II.) will serve as a general specimen of all those of the Ommiah and Abbas Khalifs. They contain the date and place of fabrication, but not the name of the prince. The coins of the Samanian dynasty in Persia differ but little in appearance; but they bear the name of the sovereign under that of the prophet. The Sultans of the Seljuk dynasty, who

* Marsden's Numismata Orientalia xvi.

arrested the whole of Asia Minor from the Empire in the 11th century, struck the emblem of the sun in the constellation of the lion upon the obverse of their coin, and these devices have since become well known as the chivalric order of distinction in Persia: its origin is referred by Marshman to the horoscope of *Gheat-ud-dín Kai Khusrú,* who began to reign in 1236. The earliest mention of it is in Tavernier's Travels, 1676. The kings of the Turkman or Ortokite dynasty, in the 13th century, introduced heads on their coin in imitation of the Syro-Macedonian kings, notwithstanding the supposed prejudice of the faithful against such devices. The Persian term *sháh,* rex, occurs for the first time on the coin of *Kutb-ud-dín Ghází,* A. H. 580. The coins of this period are so irregular, that Christian marks and names are sometimes visible on them: signs of the zodiac were also frequently introduced. The Fatimite dynasty restored the primitive form and purity of the Kufic inscriptions. Their coins have generally more than one concentric circle of inscription. They also exhibit the several localities of Arabia, Syria, Egypt, and Sicily.

The coins of the *Il-Khanian* or Moghul dynasty of Persia are known by the title of *Kaan, Khan,* and *Sultán Ahzem,* in connection with the name of the sovereign. The writing is generally contained in an ornamental or scalloped frame, such as is now common in the coins of Persia, Nipal, and other oriental countries.

These very general remarks will be sufficient to afford a clue to the classification of the coins of Persia, when the legend may not be sufficiently legible to determine them: the subject has been most ably expounded by Mr. Marsden, in the work already quoted from; and to it all must refer who would pursue this branch of numismatic study.

*Fig.* 16.—A silver coin of the Khalifs of the second century of the Hejra, bearing on the area of the obverse the usual formula in the Kufic character:

| | |
|---|---|
| لا اله الا | *Non est Deus præter* |
| الله وحده | *Deum unicum* |
| لاشريك له | *cui non est socius.* |

In a circle around which is inscribed

بسم الله ضرب هذا الدرهم بواسط سنة تسع و عشرين و ماية

*In nomine Dei cusa est hæc drachma in Wasit. Anno* 129, *nono et vicesimo et centesimo.* (A. D. 746.)

On the reverse it has the usual inscription.

| | |
|---|---|
| الله احد الله | *Deus unus, Deus* |

Pl. VI.

# PERSIAN COINS


J. Prinsep del. Kasinath Sculps.

| | |
|---|---|
| الصمد لم يلد ولم | *æternus, non gignit, et* |
| يولد و لم يكن | *non generatur et non* |
| له كفوا احد | *ei compar unus.* |

On the margin it has a quotation from the Koran (Sura ix. 33.)

محمد رسول الله ارسله بالهدى ودين الحق ليظهره على الدين كله ولو كره
المشركون

*Muhammed est legatus Dei, qui misit eum cum doctrina et religione vera, quo eam extolleret super religiones omnes si vel refragarentur associantes.*

In Hallenberg's *Numismata Orientalia* are described several coins of the same age, the nearest in point of date is one of 126 Hij. (A. D. 743.) Merwan, the son of Muhammed, &c. and 14th in descent from Ommîah, came to the Khalifat in A. H. 127; and was killed in 132, being the last Khalif of that race.

*Wasit*, the town at which the coin was struck, was so called, says the same authority, from being half-way (middle) between Basra and Kufa, it was built by Ibn-Gjuzí in 75 Hij. and remained the seat of the Khalifs and of the coinage until the Abbasidæ succeeded to the Ommian Khalifs, when the capital was established at Mohamadíah (or Bagdad) as proved by coins struck in the year 137 Hijra.

In the third volume of the GLEANINGS, Plate XXIII. are depicted four Persian gold coins, also brought from Persia by Lieut. Conolly, which appear to belong to the Seljuk dynasty. In fig. 3, the words *ul-malek* are legible, but it requires some experience in the Kufic character to decypher the remainder.

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## IV.—*Eclipses of Jupiter's Satellites.*

Observations by Walter Ewer, Esq. at Chaprah.

| | | Meam time. h. m. s. | Difference from Nautical Almanac. h. m. s. |
|---|---|---|---|
| 4th December. | Em. I. Sat. at | 8 46 34 | 5 38 50 |
| | 3½ ft. achrom. Troughton. power 80—capital observation. | | |
| 5th ......... | Em. II. Sat. at | 7 18 51 | 5 39 27 |
| | same telescope, not so good, noon being too bright. | | |
| 20th ......... | Em. I. Sat. at | 7 7 43 | 5 38 59 |
| | 5 ft. achrom. Troughton, clear and good. | | |
| 27th ......... | Em. I. Sat. at | 9 4 7.5 | 5 39 14.5 |
| | same telescope, rather hazy. | | |

V.—*A method of preparing Strychnia. By* J. T. Pearson, *Esq. Assistant Surgeon.*

The enormous price of 120 rupees having been paid at the Hon'ble Company's Dispensary for a single half ounce of strychnia; it became my duty to attempt to prepare it, by a process, more expeditious and less expensive, than that recommended in the formulary of Magendie*; and which, at the same time, should be equal to the demands made upon the department. I hope that both these objects have been effected by the following method:

Infuse a determined quantity of Nux Vomica in boiling distilled water, until it becomes soft; take it from the liquid, bruise it coarsely in a large metal mortar, and treat it with successive infusions of boiling distilled water, till it becomes nearly tasteless. Strain the liquids, and having mingled them together, boil with calcined magnesia for half an hour, and collect the precipitate upon a filter of fine muslin. When the precipitate has become free from the liquid, wash it gently, twice, as it lies on the filter, with cold distilled water, and afterwards dry it upon a water bath.

Treat the precipitate, dried as above-mentioned, with successive portions of boiling alcohol, sp. g. .838, or stronger, until it becomes quite exhausted, then mix the whole of the filtered alcoholic liquid, and evaporate in a water bath, till a thick crust forms upon the surface; set it aside to crystallize for twelve hours; pour off the mother waters, and collect and dry the strychnia upon filtering paper.

In this state, the strychnia is in small, but by no means microscopic, irregular crystals, of a light-brown colour; and it may be purified by redissolving and re-crystallizing it in boiling alcohol, or by pouring over it portions of rectified æther.

* The following is the process given by Magendie. "Add a solution of liquid subacetate of lead to a solution of alcoholic extract of the Nux Vomica in water, until no more precipitate be thrown down; the foreign matters being thus separated, the strychnine remains in solution, with a portion of colouring matter, and sometimes an excess of acetate of lead. Separate the lead by sulphuretted hydrogen, filtrate it, and boil with magnesia, which will unite with the acetic acid, and precipitate the strychnine. Wash the precipitate in cold water, redissolve it in alcohol, to separate the excess of magnesia, and by evaporating the alcohol, the strychnine is obtained in a state of purity. If it be still not perfectly white, it must he redissolved in acetic or hydrochloric acid, and reprecipitated by means of magnesia." To prepare the alcoholic extract, the Nux Vomica must be rasped and exhausted by repeated macerations in alcohol, which must then be evaporated; a process the tediousness of which can only be duly appreciated by those who have tried it, and which it was my object to avoid.

By the foregoing process, sixty-five grains of strychnia were obtained from four pounds of Nux Vomica, at a cost of three rupees: a saving at the rate of more than two hundred rupees upon a single ounce. It was much purer than that purchased, as mentioned in the beginning of this paper; and a dose of half a grain, given to rabbits, killed one in a minute and half; and another in five minutes; whilst a small dog, after having taken a grain and half fell in fourteen minutes and half, and died at the end of twenty-five. The delay in the death of the second rabbit, which did not take place until a second dose was in the act of being administered, may perhaps be attributed to the strychnia having been given in crystals instead of in powder; a state in which the difficulty of its solubility in watery secretions would of course be greatly increased. *After this, I need scarcely add, that* STRYCHNIA, *like* ARSENIC, MORPHIA, CORROSIVE SUBLIMATE, *and other strong poisons, should never be given but in* SOLUTION; *it being impossible in any other manner accurately to measure the dose.*

*Note.*—I wish it to be understood, that for the foregoing process I do not lay any claims to originality. I may however mention that beyond a knowledge that Robiquet's process for morphia had been pursued with strychnia, the details of which I have not met with, it is new to me. Should you think the subject worthy of attention, I propose to give you, in a future paper, my views of the rationale of the process, together with the results of more extended trials now going on under my superintendence at the Hon'ble Company's Dispensary.

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## VI.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 9th January,* 1833.

The Hon'ble Sir Edward Ryan, President, in the chair.

After reading the Proceedings of the last regular meeting and of the special meeting of the 19th December, the Society proceeded to ballot for the officers of the ensuing year, when Sir C. T. Metcalfe, Bart., Sir John Franks, and the Rev. Principal Mill were elected Vice-Presidents.

Mr. James Prinsep was unanimously elected Secretary.

The Rev. Dr. Carey, Mr. J. Calder, Mr. J. Tytler, Rev. Mr. Proctor, Baboo Ram Comul Sen, Mr. J. R. Colvin, Mr. D. Hare, and Dr. J. Pearson, were elected Members of the Committee of Papers.

Mr. Clemishaw and Baboo Radhacant Deb, proposed at the last meeting, were elected Members.

The Hon'ble Sir R. W. Horton, Governor of Ceylon, proposed at the last meeting by Mr. Wilson, seconded by Mr. J. Prinsep, was upon the favourable report of the Committee of Papers, unanimously elected an Honorary Member.

Sir Benjamin Malkin, Recorder of Penang, was proposed by the President, seconded by Mr. Prinsep, as an Honorary Member, and referred to the Committee of Papers.

Upon the Report of the Native Secretary, that since the retirement of Mr. Colebrooke, in the year 1830, from the office of Agent to the Society in England, no new appointment had taken place; it was resolved, that a letter be written to Mr. Wilson, requesting him to act as Agent, and to take charge of any property or money belonging to the Society in England.

Upon the suggestion of the Secretary, it was resolved, that an extract from the Proceedings of this Society, containing the Address presented to Mr. H. H. Wilson, by the Society, on the occasion of his departure from India, and his reply, be printed to accompany the Seventeenth Volume of Researches, just published under his superintendence.

Read a letter from H. M. Parker, Esq. Officiating Secretary to Government, announcing, that Government had complied with the application for freight to England of 100 copies of the Seventeenth Volume of the Researches.

The accounts of the past year were submitted, exhibiting the following Balance in the Society's favor on the 31st December, 1832.

| RECEIPTS. | | | | PAYMENTS. | | | |
|---|---|---|---|---|---|---|---|
| By Balance on the 1st May, | 11,242 | 4 | 9 | To Cash drawn from Mackintosh & Co. since 1st May, | 5,625 | 11 | 11 |
| By Collections to the 31st Dec. since paid in to Mackintosh & Co. | 6,131 | 1 | 10 | To Purchase of Govt. Loan, Rs. 25,000, lodged with the Govt. Agents, | 25,386 | 14 | 2 |
| By Legacy of £2000, left by Will of the late C. K. Bruce, with interest, recd. from Cruttenden & Co. | 25,037 | 0 | 0 | Balance with Mackintosh and Co. | 11,397 | 12 | 6 |
| | 42,410 | 6 | 7 | | 42,410 | 6 | 7 |

The Balance 11,397 12 6 is unfortunately involved in the failure of Messrs. Mackintosh and Co.

The sums due by the Society are as follows:

| | | | |
|---|---|---|---|
| To the Military Orphan Press, for Seventeenth Volume of Researches, | 4,286 | 14 | 0 |
| Mr. J. Prinsep's Bill, for Plates of the Physical Transactions, House Repairs, &c., passed by the Committee of Papers, | 1,023 | 15 | 1 |
| Establishment for December, and sundries, | 249 | 0 | 0 |
| Total, Rs. | 5,559 | 13 | 1 |

*Resolved*, that the accounts be referred to the Committee of Papers, to determine upon the best mode of liquidating the present demands.

*Museum.*

1. *Read* a letter from the Private Secretary to the Right Hon'ble Sir R. W. Horton, forwarding two antique coins for examination.

2. Three small Buddha images, presented by Baboo Ram Comul Sen, in the name of Mr. Wilson.

3. Specimens of Coal from the Kasya Hills, presented by Mr. Cracroft. Some hundred maunds of this Coal have lately been sent on trial to the Calcutta Mint, where it has been found of a quality far superior to any from the Burdwan

Collieries, for Engine and Reverberatory furnaces, in the ratio of 5 to 4, The composition of the Coal tried at the Assay Office, was,

| | |
|---|---|
| Volatile matter or gas, ...... | 38.5 |
| Carbon or coke, .. .. ...... | 60.7 |
| Earthy impurities or ash, .. | 0.8 |
| | 100.0 |

The ash is wonderfully small : specific gravity of the Coal 1.275.

4. Specimens of the Sandstone of Sikrigalí, with vegetable impressions of ferns, &c. by Dr. Langstaff.

"The sandstone appears to correspond with that from Chira Punjí with vegetable remains. This rock forms the bluff termination of the ridge immediately adjoining the river: below it, and I believe interstratified with it, is the perfectly horizontal stratum of silicious schist with impressions of ferns and mosses, and apparently the remains of shells.

"In the same situation are blocks of the hornblende rock, and basalt, abounding from Monghyr to Rajmahal. Although the trap formation is contiguous to the sandstone, the latter does not seem to have undergone any disturbance of its horizontal position, which would argue its formation to be more recent than the trap."

5. A letter from Dr. Spilsbury, announcing the dispatch of a specimen of fossil bone from Jabalpúr.

*Library.*

A copy of his work on the "Muhammedan Law of Inheritance," presented by N. B. E. Baillie, Esq.

Ditto, of the 2nd edition of Wilson's Sanscrit and English Dictionary, by the author.

*Read* a letter from M. Burnouf, the Secretary, forwarding the following works from the Asiatic Society of Paris :

Burnouf's Vendidad Sadi, parts 5th to 9th.
Cassin,—Almanach Philanthropique, 1 vol.
Levassseur and Rutz,—Tableau d'Elemens Vocaux de l'Ecriture Chinoise.
Brosset Jeune,—Chronique Georgienne, 1 vol.
Deslongchamp's Manava Dharma Sastra, 3rd part.
A. L. Chezy's Sacountala, 1 vol.

The following Books from the Book-sellers.

Niebuhr's History of Rome, 2nd vol.
Lardner's Cabinet Cyclopedia;—the United States, 2nd vol.

*Literary.*

A Paper on the Origin and Classification of the Military Tribes of Nipal, by B. H. Hodgson, Esq.

A Note by the same gentleman, on the Law and Legal Practice of Nipal, in matters of adultery or connection between a Hindoo and an outcast.

*Note on the Ceylon Coins, by the Secretary.*

The two coins transmitted by His Excellency, the Governor of Ceylon, belong to the class described by Mr. Wilson, in the seventeenth volume of the Researches, and depicted in Plate V. figure 109 to 113, which are stated, like the present coins, to have been found by Colonel

Mackenzie at Dipaldinna. No. 3, according almost exactly with the present copper coin, "is a drawing of one found at Kandya in Ceylon."

Mr. Wilson does not attempt to explain them further, than they evidently belong to a Hindoo dynasty, either on the island of Ceylon, or in the south of the peninsula. The letters are distinctly Hindí in all, although it is difficult to make out their purport. The word "*Sri*" is also evident in all of them.

*Description.*

No. 1. A gold coin, weighing 60 grains.

*Obverse.* A male figure, seated in the Indian manner, with *dhotí*. Left hand raised, and face looking to the left: on the side, the Nagari characters श्री लंके वर, *Sri Lankeswar?*

*Reverse.* A rude standing figure, with a flowing robe, right hand extended over two emblems ⚘ ±

Left hand supporting a crown or globe? Beneath a scroll, with circles or flowers on the right.

No. 2. A copper coin, very similar, but more rude. The inscription on the *obverse* is, श्री गन्या दयमथ, *Sri g nya d y m th?* On the *reverse*, the standing figure as before.

In Davy's Ceylon, page 245, will be found a drawing of an antique gold coin, called a Dambadinia Rhatra (*rhatra*, gold), which was found in the neighbourhood of Dambadinia, in the Seven Korles, a place of royal residence (no doubt identical with Dipaldinna of Col. Mackenzie.) The drawing of this coin is precisely similar to those of Plate V. and to the one now before the Society, and so is the copper coin alluded to by Davy as the Dambadinia chally (*chally*, means copper.)

Davy does not seem to have comprehended either the device or the characters on his coin, for he has reversed the engraving of the side bearing the inscription, and he supposes both to be mere hieroglyphics. To an eye accustomed to such objects, however, the standing and sitting figures are very evident, as are the Nagari characters, although their purport is not so clear: indeed, of the half dozen, to which we can now refer, no two seem to bear the same name, nor are we acquainted sufficiently with the ancient history of Ceylon, to be able to fill up the doubtful names on the coins from any well certified list of princes of the Hindú dynasties in Ceylon of the *Soorea-wansé* (or *Súrj-bansí*) race.

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## VII.—*Miscellaneous.*

### 1.—*Hot-spring at Pachete. By* C. Betts, Esq.

As a correspodent of the *Journal* is desirous of knowing the localities of any hot-springs met with in India, I beg to put on record this notice of one found by me in the river Damuda, near the Tántotya village, and about six miles distant from the Pachete hills. In the cold season, when the river is very low the thermometer plunged into it rose to 190° Farh. The spring is slightly chalybeate.

2.—*Extraordinary Banyan Tree at Kulow Nagty Hally, near Bhuoma Naik Droog. in the territory of Mysore.*

This tree assumes to the traveller's eye the appearance of a very beautiful grove, which in reality it is.

The centre tree is about fifty or sixty feet in height, and its branches cover an area of seventy-six yards in one direction, and eighty-eight in the other, while the drops now dependent from, or rather supporting, its gigantic branches, amount in number to one hundred and twenty-one, of which some are of enormous size. The place exhibits on all sides vast branches, broken off, which have been evidently once connected with thirty trees, now disunited from the centre stock; but the original connexion can still be sufficiently traced to render unnecessary the testimony of the villagers, who state that they and their fathers have been in the habit of disuniting these trees by separating the intermediate parts for the construction of solid cart wheels, for which, from their size, they are well suited. On measuring the transverse diameters of the whole area, they were found to contain more than 100 yards each way. This single tree thus affording a circle of foliage and shade exceeding 300 English yards in circumference.

3.—*Discovery of the Silhet Coal Mines.*

Mr. James Stark discovered, early in 1815, some coal mines on the lower hills of Silhet, and worked them sufficiently deep to send down samples to the Government through Mr. Dacosta. By directions from Mr. A. Trotter, then Secretary, Public Department, about 50 maunds were sent to the foundery in Fort William, the same quantity to the gun-carriage yard at Cossipore, and an equal quantity was tried in the Mint, as also 25 maunds at Mr. Jessop's. The reports on these samples proving favorable, Mr. Stark submitted proposals for supplying Government with coals, at 1 rupee 8 annas per maund, to any extent required, of the quality of the samples sent, and even superior; these being declined, he next obtained the indulgence of Government to import into Calcutta duty-free, for five years. The first thousand maunds having arrived in Calcutta, and remaining on hand unsold, he abandoned the mines.

5.—*Questions proposed by the Burmese Heir Apparent.*

"The Philosopher Burmese Prince is an extraordinary man. He is self-taught, and although of naturally good talents, he is very timid, and much alarmed that his turn for scientific subjects should be known to the King and Ministers. A gentleman who has also a turn that way, and has seen him frequently, declares him to be a wonderful man, and if in any other country but this, where he could without fear follow the bent of his mind, he would soon prove himself a person of superior acquirements. He is anxiously looking out for a Comet that is to appear this month, and which I believe by the calculations of some French Astronomer is to destroy the earth. He has a very good Telescope—a Thermometer—a Barometer—a Stomach Pump, and I believe an Air Pump—all of which he is obliged to keep shut up. Subjoined are some questions put by him to a gentleman here, which it is hoped some one may be able to solve for his satisfaction.

1st. He has observed, that the last three Comets have appeared in the same sign in the heavens, that the Moon's node was in at the time; is this accidental, or has the node any connection with Comets ?

2nd. On what data does Sir Isaac Newton found his hypothesis of the heat of a Comet being 900 times greater than that of red-hot iron ?

3rd. Is not the height of the atmosphere increased at new and full moon in the same manner that the waters of the ocean are raised, but to a much greater extent ? If so why does not the Barometer indicate it by rising ?"

## VIII.—*Progress of European Science.*

### PRACTICAL ASTRONOMY.

Under this head may be comprehended all proceedings intended to bring us better acquainted with the phenomena of the heavenly bodies through the medium of observation and experiment:—the labours of astronomers in their observatories; the construction of new instruments; of new tables to facilitate calculations; of new maps of the heavens, &c. to which may be added pendulum experiments and the various geodetical operations on a grand scale, destined to the determination of the earth's figure. Of the latter branch of our subject, we have on a former occasion taken a cursory review, adverting to the survey now in progress in our own neighbourhood. In our last number also we anticipated the present notice by inserting an abstract of the contents of the new Nautical Almanac, which itself marks the progress of astronomical science, by the new wants that it is found necessary to supply to the practical astronomer to save the waste of his time in intricate calculations. We will now advert to the increased means set at work in the world for the pursuit of this noble and heart expanding-study, taking as our guide the annual reports of the president of the Astronomical Society: for in the present day, thanks to the systematic division of the sciences among their proper societies, information on each separate branch can be obtained at once without spending much time in searching through scattered notices in journals of general science.

Mr. SOUTH, in his address on the anniversary of February, 1830, congratulated the Society on the prosperous appearance of the astronomical horizon. He attributed with justice to the influence of the institution over which he presided, a part of the unusual activity prevalent, as well abroad as at home, in prosecuting observations, and in perfecting the theories and tables of celestial phenomena.

He noticed the establishment of no less than two new observatories endowed by the British Government: one at the Cape of Good Hope, under the Rev. Mr. FALLOWS; the other, the Paramatta Observatory, originally founded by Sir THOMAS BRISBANE in New South Wales, now converted into a permanent public institution. The East India Company had been equally active: they had remodelled their observatory at Madras, furnishing it with new instruments and appointing to the charge of them Mr. TAYLOR, an experienced astronomer from the Greenwich Observatory. An attempt had before been made to found an observatory at Bombay, which had failed through the bad management of the astronomer nominated there. At the anniversary of last February, the same illustrious president noticed the foundation of another observatory by the Company, in the Island of St. Helena, under the charge of Mr. JOHNSON: and *pari passu,* the British Government had presented a $3\frac{1}{2}$ feet transit, by Troughton, and other valuable instruments, to the private observatory of M. DABADIE, on the Island of Mauritius, whither also a number of excellent instruments had been carried by Captain LLOYD, Surveyor General to the colony. Monsieur DABADIE'S observations on the Comet of 1830 have brought this well-merited reward, not to himself alone, but generally to the zealous exertions of this scientific little island, which can boast of more than its due proportion of naturalists and literary men. Astronomy is well adapted to be the study of an insulated quiet seat of contemplation like this isle, or St. Helena, and some questions of great practical importance, such as that of the refraction on the oceanic horizon, might here be more successfully investigated than any where else.

Captain KING, R. N. also is mentioned as proceeding to New South Wales, provided with superior instruments for his own use.

Here is a goodly list of the astronomical emissaries from our own island, and yet it is doubtless full of omissions : for the amateurs must be more numerous in this than in any other science. Nothing of course was yet known in England of the appointment of Captain HERBERT as astronomer to the KING of Oude. From the magnificence conspicuous in all oriental undertakings, we may safely prognosticate, that the Lucknow Observatory will become a richly endowed establishment, if the life of the founder be spared to complete it. We cannot pause to follow the list of illustrious observers enumerated in Great Britain itself, at Cambridge, Dublin, Greenwich, Kew, London, and Edinburgh : nor of those on the continent, where the activity of the new observatories of Brussels, Cadiz, Cracow, and Geneva, are stated to be already rivalling the older establishments of Paris, Berlin, Moscow, Florence, and Vienna. Now let us see what has been produced at these rival observatories, for that is the best way to judge of their relative and positive merits.

The Greenwich Observatory has lately issued a *catalogue* of 720 *stars :* selected and reduced from the catalogue formerly published by the Astronomical Society. This fundamental catalogue has now reached a degree of accuracy unexampled in astronomical history, and bids fair to preserve the credit of "*the British Catalogue*" of the good old times of FLAMSTEAD.

The Paris Observatory seems to have been dormant for a long time. A new transit and a splendid equatorial by *Gambey* have once more set it in activity, and an excellent rule of the Institute has imposed upon the superintendent the necessity of never being more than a year behind hand in publishing the results of his labours.

Professor BESSEL has been employed upon pendulum investigations, and has come to the mortifying conclusion, that the corrections employed by British experimentalists are by no means correct ! Mr. FRANCIS BAILY also has demonstrated the existence of certain imperfections in the apparatus which point out the necessity of fresh inquiries before the standards of weights and measures, upon which such care has already been spent, can be considered as finally settled !

Professor ENCKE has entitled himself as much to the gratitude of astronomers in general, as to the medal so justly awarded him by the Astronomical Society, for the *Berlin Ephemeris*, which bears his name. While the Nautical Almanac has been gradually retrograding, and the *Connoissance des tems* stationary, the Berlin Almanac has suddenly stept in advance of both, and so full are its contents, and so excellent its arrangement, that, as Mr. SOUTH says, " with it an observatory scarcely wants a single book ; without it, every one." The new Nautical Almanac will be one of the fruits for which we are indebted to ENCKE's example, and we hope it may prove, according to the President's promise, " as superior to ENCKE's, as ENCKE's is now superior to it."

The Royal Academy at Berlin has carried into complete effect its plan for a minute survey of the heaven, and for the formation of a new set of celestial charts. Three portions of this useful and valuable undertaking are already published : viz, the 10th hour in AR by professor GÖBEL of Coburg, the 14th hour by the Rev. T. J. HUSSEY of Chisleburst, and the 18th hour by Padre GIOVANNI INGHIRAMI of Florence, and M. CAPOCCI of Naples. The catalogues contain a list of all the stars (reduced to the year 1800) within 15° of the equator down to the 10th magnitude : and when complete, will be a most valuable acquisition to the practical astronomer.

Of the labours of one member of our own Royal Observatory, we must take a fuller review : we allude to those of Mr. RICHARDSON on the *constant of aberration.*

In extracting for this purpose the words of Mr. SOUTH's address on presenting the author with the gold medal, we are in fact giving a most luminous and interesting review of the history of this subject, so closely connected with the demonstration of the Copernican system.

"Three hundred years have now elapsed since COPERNICUS proposed to the world that system which bears his name; and if we except the labours of TYCHO BRAHE, who, besides a catalogue of 800 stars, made attempts to determine the altitude of the pole-star at different seasons of the year, little was done by practical observation to support or refute the ideas of COPERNICUS till the time of GALILEO. Observations of the eclipses of *Jupiter's* satellites induced him to propose them as a means of determining differences of longitude, whilst his discovery of the phases of *Venus* removed a serious objection to the truth of the Copernican system, and which COPERNICUS himself predicted would be removed, though he had not the means of doing so himself. About the year 1665, HUYGENS, by his invention of the pendulum clock, gave to astronomical observations an accuracy hitherto unknown; and CASSINI, by means of the excellent glasses of CAMPANI, accumulated a vast mass of observations of the eclipses of *Jupiter's* satellites, and deduced from them tables whereby astronomers could predict their occurrence.

"Notwithstanding the powerful arguments advanced in its favour, the Copernican hypothesis was not generally embraced; for in the year 1669, nearly a century and a half subsequent to its promulgation by COPERNICUS, even the celebrated HOOK, to use his own words, 'would not absolutely declare for it*.' To settle the matter, therefore, this extraordinary man, feeling that the instruments of TYCHO, although magnificent beyond all others, were, from the nature of their construction, and from their being unprovided with telescopic sights, incompetent to detect minute alterations of sidereal positions, and knowing that the laws which governed refraction were so little understood† as to render all observations in which that element was materially involved, liable to errors greater probably than the quantities he was in search of, invented the zenith sector. It was erected at Gresham College, and consisted of a telescope, 36 feet long, a divided arc, and a plumb-line. The star selected for observation, and with reference to which, indeed, his instrument was entirely constructed, was one which passed within two or three minutes of the zenith of Gresham College; it was visible in the day-time throughout the year, and was $\gamma$ *Draconis*: by observing its zenith distance when the earth was in opposite points of her orbit, he found (as he erroneously concluded) a sensible parallax, amounting to about 20 seconds, and, consequently, determined that the Copernican system was the true one‡.

"In the mean time, the eclipses of *Jupiter's* satellites, thanks to the facilities of predicting them, afforded by CASSINI's tables, had been assiduously observed; and in the year 1675, the discordances found between the predicted and the observed eclipses enabled the celebrated ROEMER to demonstrate that light was not instantaneously propagated, and that the discordances between the tables and the observations might be considered as the measure of its velocity.

"The year of ROEMER's discovery was further marked by another epoch in astronomical history, namely, the foundation of the Royal Observatory. FLAMSTEAD,

* An attempt to prove the motion of the earth from observations made dy ROBERT HOOKE, F. R. S. pp. 5 and 7.

† Idem, pp. 10 and 11.

‡ Idem, p. 25.

with his mural quadrant, detected a change of place in the pole-star, amounting to 35, 40, or 45 seconds, attributed it to parallax, and regarded it as confirmatory of HOOK's discovery. Indeed, the observations of HOOK, as well as of those who preceded him, although nominally in search of parallax, had for their object little else than the confirmation or verification of the Copernican system; and this arrived at, there seems to have been but little disposition to repeat them.

"Hence it was that the brilliant discoveries of NEWTON having placed the accuracy of the Copernican system beyond all possibility of doubt, the investigation of parallax was not resumed till the latter end of November, in the year 1725, at which time MOLYNEUX erected his 24-feet zenith sector, by GRAHAM, in his observatory at Kew*. 'On the 3rd of December, $\gamma$ *Draconis* was, for the first time, observed as it passed near the zenith, and its situation carefully taken with the instrument; and again, on the 5th, 11th, and 12th, when, no material change in the star's place having been detected, further observations seemed needless, since it was a time of the year when no sensible alteration of parallax could soon be expected.' BRADLEY, however, being on a visit to his friend MOLYNEUX, was 'tempted by curiosity to repeat the observation on the 17th, and perceived the star pass a little more southerly than when it had been observed before:' suspecting that the apparent change of place might be owing to erroneous observation, it was observed again on the 20th, and he found the star still farther south than in the preceding observations. This sensible alteration surprised himself and MOLYNEUX, in as much as it was the contrary way from which it would have been, had it proceeded from an annual parallax of the star; but being incapable of accounting for it by want of exactness in the observations, and having no notion of any other cause from which such apparent motion could proceed, they suspected that some change in the materials of the instrument itself might have occasioned it. Under this apprehension, they remained some time, but being at length fully convinced, by repeated trials, of the great exactnesss of the instrument, and finding, by the gradual increase of the star's distance from the pole, that there must be some regular cause which produced it, they examined nicely at the time of each observation how much it was; and about the beginning of March, 1726, the star was found to be 20″ more southerly than at the time of the first observation. It now, indeed, seemed to have arrived at its utmost limit southward; for in several observations made about this time, no sensible difference could be detected in its situation. By the middle of April, it appeared to be returning towards the north, and about the beginning of June, it passed at the same distance from the zenith as it had done in December, when it was first observed. From the quick change in the star's declination about this time (it increasing a second in three days), they concluded that it would now proceed northward, as it before had gone southward of its present situation; and it happened as was conjectured; for it continued to move northward till September following, when it again became stationary, being then near 20″ more northerly than in June, and no less than 39″ more northerly than it had been in March. From September, it returned towards the south, till it arrived, in December, at the very same situation it had been at that time twelve months, allowing for the difference of declination 'on account of the precession of the equinox.'

"Such is a brief history of the Kew observations; commenced, indeed, for the determination of sensible parallax, but which, as subsequently in the hands of HER-

* Philosophical Transactions, vol. xxxv. p. 639.

SCHEL, led to a very different result. In reading it, we are at a loss whether most to admire the mode in which the observations were conducted, or the modest unassuming manner in which they are recorded: no possible source of error is allowed to pass without the most rigid examination—no theory suffered to embarrass the observers in their observations; the slightest anomaly became the subject of suspicion, till in presumed anomaly was found the most perfect regularity.

"That observations so conducted, leading to results so unexpected, could be abandoned till the law which governed them should be unfolded, was impossible. But BRADLEY rejected all inquiries into the cause till the effects were accurately determined; and feeling that the apparent motion was obtained by observations only of one year—by one instrument—and by one star,—he erected at Wanstead, aided by his friend GRAHAM, on the 19th of August, 1727, his zenith sector of 12½ feet focus, formed, indeed, upon the same general plan of MOLYNEUX's, but furnished with a divided arc of 6¼ degrees on each side of the zenith point, for the purpose of enabling him to ascertain, by direct observation, whether other stars than $\gamma$ *Draconis* would be similarly affected. The instrument's situation, when adjusted, 'might be securely depended upon to half a second,' and its telescope could be directed to 'not less than 12 stars, bright enough to be seen in the day-time,' throughout the year: the same changes were observed as had been previously detected with MOLYNEUX's instrument. Inflexible, however, in his resolution not to generalise till sufficient means were collected to lead him to a 'probably just conclusion,' the year of probation was suffered to be completed before 'the observations were examined and compared:' *then* it was that he satisfied himself of the general laws of the phenomena, and *then*, and not *till then*, did he endeavour to find out their cause. Convinced that the apparent motion of the stars which he had observed was not owing to nutation—persuaded, that a change in the direction of the plumb-line with which the instrument was rectified was insufficient to have occasioned it—and having appealed unsuccessfully to refraction,—he perceived, 'that if light was propagated in time, the apparent place of a fixed object would not be the same when the eye is at rest, as when it is moving in any other direction than that of the line passing through the eye and the object; and that when the eye is moving in different directions, the apparent place of the object would be different.' He therefore announced his discovery in these words: 'That all the phenomena proceeded from the progressive motion of light and the earth's annual motion in its orbit,' or, as he afterwards called it, aberration of light.

"But he who determined its existence determined also its constant, and fixed it at 20″; giving us, therefore, the interval of time in which light travels from the sun to the earth, as eight minutes and seven seconds, differing from that deduced by ROEMER nearly three minutes of time, a circumstance not at all to the discredit of ROEMER, considering the imperfect knowledge of the theory of *Jupiter's* satellites at the time he made his important discovery.

"The observations, however, which led BRADLEY to the discovery of aberration, and to the determination of its constant, being as yet unpublished, have given rise to insinuations certainly ungenerous, and probably unjust. Impelled by more honourable feelings, our illustrious associate BESSEL, alluding to the observations of $\gamma$ *Draconis* made by BRADLEY when the sector was removed to Greenwich, says*, '*Cæterùm* BRADELII *observationes Wansteadianæ liberari possunt à sectoris mutabilitate, quum sæpiùs, eodem tempore, observatæ sint stellæ, in quibus aberrationi*

* Fundamenta Astronomiæ, p. 124.

*contraria fuerunt signa : quâ de causâ, et propter observationum præstantiam, optabile esset reperire ipsa* Bradleii *autographa.'* It will, therefore, be highly grateful to him, and to astronomers in general, to be informed from this chair, that the manuscripts of the Wanstead observations are found!—that to the honour of the University of Oxford, twenty-three sheets of them are already printed; and that the volume will be presented to the public with as little delay as possible, under the superintendence of Professor Rigaud.

"Till within these few years, the constant, as determined by Bradley, was universally employed in all our astronomical reductions; recently, however, astronomers have re-investigated it. Delambre, from the eclipses of *Jupiter's* satellites regards it 20″,25. Bessel, from Bradley's Observations made at the Royal Observatory, after he was appointed Astronomer Royal, has deduced for the constant 20″,68. Lindenau, by comparisons of Bradley's, Maskelyne's, Bessel's, and Pond's observations of *Polaris*, has obtained for it 20″,61. Brinkley, from his own observations, considers it as 20″, 37. Whilst Struve, by his observations, draws almost the same inference, namely 20″,35.

"Such were the results most entitled to our confidence, when Mr. Richardson, in the hours allotted to him for repose or recreation, undertook those labours which form the subject of our present consideration, and of which the following is a brief outline. A second mural circle by Jones, after the model of that of Troughton's, having been erected at the Royal Observatory, in the April of 1825, corresponding observations with the two instruments were carried on simultaneously; they were confined, indeed to a few stars, but every precaution to render them as accurate as possible was adopted. Thus, the index error of each instrument was ascertained by observing the same star alternately, by direct vision and reflection; each pair, therefore, giving to its respective instrument one horizontal point perfectly independent of astronomical tables, the final accuracy of the determination of the index error being directly as the number of pairs observed. Throughout the observations, the place of each star was arrived at by reference to the six microscopes of each circle; care also being taken to equalise, as nearly as possible, the temperature of the observatory with that of the external air, so that errors to any extent, arising from partial expansions or erroneous divisions of the instrument, were effectually excluded.

"From such unexceptionable data, fourteen stars were selected by Mr. Richardson as the fittest for his purpose, being those the least affected by refraction, and the most affected by aberration, so that the errors of observation might have the minimum influence upon the results. Upwards of 4000 observations he separately discussed, and in no instance was the actual aberration of each observed star less than 14″; and the conclusion to which he has arrived is, from Troughton's circle, that the Constant of Aberration is 20″,505; whilst by Jones's, it is 20″,502; the one differing from the other but three-thousandths of a second.

"Hook, in searching for parallax, was misled by his instrument. Bradley, in detecting it was unsuccessful, but discovered aberration. Hook's instrument was the work of his own hands; Bradley's was the work of Graham. Sensible that much of his astronomical glory was referable to the accuracy of his instrument, the amateur astronomer of Wanstead was ever ready to acknowledge it; and when we consider that one hundred years' improvement in astronomical manipulations can alter the constant of aberration as determined by him but one half second, we are almost led to exclaim '*quando ullum inveniemus parem?*'

"Our GRAHAM is amongst us; to him we are indebted for the instruments with which results thus important have been obtained, and also for the mode of using them, through which the maximum of accuracy has been acquired. One of them, was made wîth his own hands, the other under his direction; and it is not too much to say, that the disciple has shewn himself worthy of his master. The benefits which EDWARD TROUGHTON has conferred on science are too well known to need enumeration. His Majesty the King of Denmark, not insensible to the importance of science, and feeling that for much of the accuracy to which astronomy and navigation have arrived, we are indebted to the genius of our revered member, has recently acknowledged his gratitude to him, by the presentation of his gold medal, inscribed with the word 'MERITO.' Never was inscription more appropriate. May he live long to enjoy this token of respect! alike honourable to himself and to the princely feelings of its royal donor.

"On looking over the constant as determined by each star, nothing definitive, as Mr. RICHARDSON justly observes, can be concluded, as to whether light emitted from different stars is propagated to us with different degrees of velocity: the idea is not irrational, but its validity future astronomers must determine."

Before concluding our imperfect sketch of what have been the labours of astronomers in Europe, we must not overlook the works of our countrymen in the East. The Madras Observatory has been newly modelled, it is true; but in its olden state, under the indefatigable GOLDINGHAM, it was turned to the best purpose, as is proved by the creditable volumes published from time to time under great disadvantage from the want of a good printing establishment. A volume of the observations in 1831 is just announced to the public, and we know that they have been reduced and arranged with great care by Mr. TAYLOR, who, although now commencing a new career with more powerful and perfect means at his command, knows how to appreciate the talents and care of his able predecessor.

Among the deaths of eminent astronomers noticed at the last annual meeting were those of the Rev. F. FALLOWS, late astronomer at the Cape of Good Hope; Capt. FOSTER, R. N;—M. PONS of Marlia, and the ABBE GREGOIRE. Mr. FALLOWS was appointed to the Cape early in 1821, and he reached it in the 12th August.

"His first undertaking was an approximate catalogue of 275 principal stars, published in the Phil. Trans. 1824. From the description of the instruments employed, it will be seen, that they were of a very humble description, viz. a portable transit of only twenty inches focal length, and a very indifferent altitude and azimuth instrument by Ramsden, ill divided, and unstable in its adjustments, being indeed originally constructed as an equatorial. It is probable that the length of time which must necessarily elapse between the design and completion of a first-rate observatory, in a foreign station, was not fully taken in to account, either by the Government or the astronomer, otherwise the temporary instruments would, doubtless have been of a very different class. The plan of the observatory was received by Mr. FALLOWS in the latter part of 1825, and he immediately proceeded to carry it into effect. A site was selected about three miles from Cape Town, and Mr. FALLOWS lived in a tent on the spot, to determine the lines of the building and to superintend the workmen. The foundations were dug out before the clerk of the works arrived to relieve him from this task.

"In the beginning of 1829, the transit and mural circle were fixed in their places, and we might now have anticipated a season of enjoyment for the Cape astronomer but for some cause hitherto unexplained, the circle to which he had looked forward with pride and exultation proved for a long time a source of bitter uneasiness. Some part of this must doubtless be attributed to the shattered state of the observer's health; but the fact, that 'the index error of two opposite microscopes was ever variable in different parts of the instrument, while with three microscopes, at 120° distance from each other, or with the whole six, the index error was nearly constant,' was sufficiently startling to harrass a person of less sanguine and zealous temper. Finally, Mr. FALLOWS was of opinion, that some permanent injury had been received by the circle and axis, from a fall which the package received whilst it was removing from the hold of the ship at the time of landing, but that the mean of the six microscopes might be fully depended upon, since high and low stars, when observed directly and by reflexion, gave the same position of the horizontal point. Before he had come to this conclusion, which seems to have been some time in the middle of 1830, sickness deprived him of the services of his assistant, Capt. RONALD, and Mr. FALLOWS was left, unaided, to do the best he might with a transit and mural circle. He was relieved from this difficulty by the affection and intelligence of Mrs. FALLOWS, who offered to undertake the circle observations while he was engaged with the transit, a very little instruction sufficed to render her perfectly competent for this task: and the Cape astronomer had like HEVELIUS, the pleasure of finding his best assistant in the partner of his affections. Some of his letters, written at this time, express a strong hope and confidence that he should at length be able to justify the high expectations which had been formed of the observatory, and that his work would bear a comparison in accuracy, though not in extent, with that of any other establishment.

"But the labours of the observatory were too much for a constitution already much enfeebled by previous illness. He had suffered very severely from a *coup de soleil*, soon after his arrival at the Cape, while fixing the small transit; and besides some less serious complaints, experienced a dangerous attack of scarlet fever in the summer of 1830, from which he seems never to have fully recovered. In the beginning of 1831, his health was visibly impaired, but he could not be induced to leave the observatory before the equinox. Towards the end of March, he became incapable of struggling any longer with the disease, and went to Simon's Town: but it was now too late, and he breathed his last on the 25th July, 1831, in the forty-third year of his age."

Mr. T. HENDERSON, well known as one of the most active and enlightened cultivators of astronomy, has been appointed to succeed Mr. FALLOWS, with Mr. MEADOWS, as his assistant.

Captain FOSTER (known as the companion of Capt. PARRY in his voyage to the north pole) was unfortunately drowned while descending the River Chagres, in a canoe, towards his ship the Chanticleer, then lying at anchor. He had nearly completed his experimental voyage, the object of which was to swing Kater's convertible pendulum near the equator, and in various places in the southern hemisphere. He had performed this task at fourteen different places, and had amassed a series of 1017 observations, arranged with such system in printed registers that there will be little difficulty in digesting the results.

M. PONS belonged to the observatory of Marseilles, where he became known from his steady attention to the discovery of comets: indeed in the beginning of his career he was put at the head of an observatory at Lucca by Maria Louisa of Bourbon, with provision that he should receive 100 dollars from the Queen's purse for every comet he might discover!

*Meteorological Observations made at the Assay Office, Calcutta, for the month of January, 1833.*

| Day of the month. | Barometer reduced to 32° Farh. At 5 A. M. | At 10 A.M. | At 4 P. M. | At 10½P.M. | Temperature of the Air in an open Véranda. Minimum 5 A. M. | At 10 A.M. | Register-ed max. | At 4 P. M. | At 10½P.M. | Depression of the moist-bulb Thermometer. At 5 A. M. | At 10 A. M. | At 4 P. M. | At 10½P.M. | Hair Hygro-meter. At 10 A. M. | At 4 P. M. | Wind. Morning. | Noon. | Evening. | Rain. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30,151 | ,221 | ,100 | ,174 | 54,0 | 60, | 75, | 65,2 | 58,2 | 7,0 | 9,5 | 11,7 | 11,2 | 81 | 86 | n. | n. | n. | | clear. | clear. | clear. |
| 2 | ,121 | ,191 | ,042 | ,130 | 50,0 | 60,4 | 75, | 65,2 | 59,9 | 4,0 | 9,2 | 10,7 | 11,2 | 80 | 72 | do. | n. w. | n. w. | | ditto. | ditto. | ditto. |
| 3 | ,095 | ,138 | ,016 | ,035 | 53.2 | 62,8 | 76,2 | 65,5 | 61,0 | 4,2 | 8,2 | 9,8 | 9,8 | 83 | 78 | n. w. | w. | cm. | | ditto. | cistr. | ditto. |
| 4 | ,021 | ,111 | ,000 | ,063 | 56,0 | 64,0 | 80,7 | 69,0 | 64,5 | 4,2 | 8,2 | 11,4 | 5,9 | 83 | 73 | n. e. | cm. | n. | | ditto. | clear. | ditto. |
| 5 | ,016 | ,119 | ,021 | ,117 | 57,0 | 65,5 | 81,4 | 70,4 | 65,5 | 3,3 | 7,2 | 9,6 | 7,7 | 86 | 82 | cm. | ne. | n. e. | | ditto. | ditto. | ditto. |
| 6 | ,108 | ,125 | ,050 | ,139 | 60,3 | 66,0 | 80,2 | 73,0 | 69,2 | 5,3 | 6,5 | 9,6 | 7,8 | 88 | 80 | n. e. | do. | cm. | | ditto. | ditto. | ditto. |
| 7 | ,101 | ,152 | ,996 | ,057 | 62,5 | 67,7 | 86,2 | 75,0 | 68,4 | 3,5 | 5,9 | 9,6 | 6,2 | 90 | 81 | cm. | s. w. | w. | | fog. | ditto. | ditto. |
| 8 | ,026 | ,097 | ,972 | ,028 | 64,4 | 69,7 | 85, | 73,1 | 70,4 | 4,7 | 5,1 | 11,5 | 9,9 | 92 | 80 | n. e. | do. | cm. | | clear. | ditto. | ditto. |
| 9 | ,024 | ,111 | ,992 | ,064 | 62,4 | 68,3 | 86,7 | 73,2 | 66,4 | 1,4 | 7,0 | 12,5 | 8,9 | 88 | 74 | w. | n. w. | do. | | ditto. | ditto. | ditto. |
| 10 | ,044 | ,120 | ,993 | ,042 | 64,1 | 68,3 | 86, | 73,0 | 67,8 | 8,9 | 7,1 | 13,2 | 11,3 | 85 | 74 | do. | w. | w. | | ditto. | ditto. | cirstr. |
| 11 | ,016 | ,057 | ,936 | ,964 | 60,0 | 68,2 | 85,5 | 72,9 | 67,2 | 5,0 | 7,6 | 11,8 | 6,0 | 87 | 79 | n. | n. | n. w. | | ditto. | cirrus. | cir. |
| 12 | 29,935 | ,997 | ,851 | ,931 | 60,4 | 67,7 | 86,8 | 74,6 | 68,2 | 2,6 | 7,7 | 12,6 | 10,4 | 88 | 85 | cm. | s. w. | w. | | ditto. | clear. | clear. |
| 13 | ,884 | ,965 | ,820 | ,867 | 64,3 | 68,2 | 86, | 74,5 | 67,2 | 11,1 | 7,5 | 12,4 | 2,1 | 88 | 79 | s. e. | do. | s. e. | | fog. | cirstr. | ditto. |
| 14 | ,843 | ,931 | ,840 | ,979 | 65,7 | 70,8 | 85,2 | 74,5 | 65,2 | 11,9 | 7,3 | 12,2 | 6,9 | 88 | 77 | s. w. | n. w. | cm. | | cirrus. | clear. | ditto. |
| 15 | ,983 | ,051 | ,944 | ,018 | 65,2 | 71,8 | 84, | 73,8 | 69,0 | 9,4 | 11,3 | 11,2 | 8,0 | 80 | 80 | n. e. | n. | w. | | clear. | ditto. | ditto. |
| 16 | ,933 | ,010 | ,835 | ,917 | 60,0 | 70,6 | 83,5 | 74,8 | 67,1 | 6,5 | 9,4 | 13,1 | 6,4 | 82 | 76 | n. | s. w. | cm. | | ditto. | ditto. | ditto. |
| 17 | ,883 | ,966 | ,889 | ,932 | 63,2 | 70,6 | 82,0 | 74,8 | 70,0 | 3,1 | 7,3 | 10,8 | 10,5 | 88 | 82 | s. e. | e. | n. | | foggy. | ditto. | cum. |
| 18 | ,932 | ,979 | ,927 | ,042 | 63,0 | 71,0 | 81, | 70,0 | 68,0 | 3,5 | 7,7 | 8,2 | 7,4 | 89 | 88 | n. e | n. | do. | 0,05 | nimbus. | nimbus. | cicum. |
| 19 | 30,025 | ,096 | ,995 | ,092 | 62,2 | 68,0 | 80,2 | 71,3 | 66,5 | 4,0 | 6,4 | 12,9 | 5,8 | 91 | 77 | n. w. | n. w. | do. | | clear. | clear. | clear. |
| 20 | 29,978 | ,135 | .033 | ,102 | 61,8 | 67,3 | 80, | 71,0 | 66,1 | 4,6 | 8,4 | 12,3 | 8,6 | 85 | 78 | n. e. | n. | do. | | ditto. | ditto. | ditto. |
| 21 | 30,084 | ,147 | ,053 | ,109 | 61,0 | 66,8 | 79, | 70,4 | 65,2 | 5,0 | 13,8 | 12,0 | 5,1 | 77 | 78 | cm. | n. e. | cm. | | ditto. | ditto. | ditto. |
| 22 | ,062 | ,128 | ,039 | ,089 | 60,8 | 66,2 | 78,5 | 71,4 | 63,4 | 2,8 | 9,4 | 13,4 | 2,3 | 82 | 74 | n. | do. | w. | | ditto. | ditto. | ditto. |
| 23 | ,066 | ,128 | ,030 | ,116 | 64,4 | 66,8 | 78,2 | 72,0 | 64,7 | 6,2 | 10,0 | 11,6 | 7,7 | 81 | 80 | cm. | do. | do. | | ditto. | ditto. | ditto. |
| 24 | ,119 | ,140 | ,053 | ,130 | 58,0 | 68,7 | 79,1 | 71,2 | 64,0 | 5,0 | 9,1 | 10,4 | 7,3 | 84 | 83 | n. e. | do. | n. e. | | ditto. | cirrus. | cir. |
| 25 | ,154 | ,150 | ,036 | ,108 | 62,5 | 68,8 | 78,8 | 74,2 | 68,0 | 8,3 | 10,2 | 11,7 | 7,5 | 83 | 81 | do. | s. e. | cm. | | ditto. | clear. | cl. |
| 26 | ,089 | ,120 | ,028 | ,136 | 64,0 | 68,5 | 78,5 | 74,0 | 67,2 | 6,4 | 9,7 | 11,5 | 4,2 | 83 | 80 | do. | s. | s. | | stratus. | cum. | nimbus. |
| 27 | ,106 | ,100 | ,988 | ,118 | 60,8 | 68,3 | 79,2 | 73,9 | 68,7 | 6,7 | 9,3 | 11,7 | 11,7 | 84 | 80 | n. w. | w. | cm. | | clear. | clear. | cl. |
| 28 | ,088 | ,150 | ,007 | ,115 | 63,0 | 68,2 | 79,5 | 73.8 | 69,2 | 5,4 | 8,9 | 11,8 | 7,2 | 85 | 79 | cm. | n. | n. | | ditto. | ditto. | ditto. |
| 29 | ,095 | ,139 | ,019 | ,123 | 64,2 | 69,8 | 81,6 | 74,3 | 68,2 | 9,2 | 8,7 | 12,1 | 10,0 | 85 | 76 | n. | do. | do. | | ditto. | ditto. | ditto. |
| 30 | ,050 | ,087 | ,942 | ,989 | 63,5 | 69,9 | 80,8 | 74,8 | 66,3 | 7,1 | 9,1 | 12,4 | 5,5 | 84 | 78 | do. | do. | do. | | ditto. | ditto. | cir. |
| 31 | 29,984 | ,030 | ,911 | ,020 | 64,2 | 70,9 | 81,3 | 76,8 | 68,8 | 5,6 | 9,1 | 12,1 | 7,5 | 88 | 80 | do. | do. | w. | | ditto. | ditto. | cirstr. |
| Means | 30,036 | ,095 | ,979 | ,056 | 61,1 | 68,0 | 81,3 | 72,4 | 66,4 | 5,8 | 8,4 | 11,6 | 7,7 | 85 | 78 | northerly. | | | 0,05 | fine clear dry weather. | | |

**NOTE.**—As the Meteorological Register kept at the Surveyer General's Office is now issued without the corrections for the temperature of the Mercury, &c. it has been found convenient to substitute the Table of Observations made at the Assay Office, and to alter the form so as to shew the ranges of pressure, temperature, and moisture more compactly. The Barometer stands 0,020 lower than the instrument at the Surveyor General's.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

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### I.—*Note on the Origin of the Kála-Chakra and Adi-Buddha Systems. By Mr.* Alex. Csoma de Körös.

The peculiar religious system entitled the *Kála-Chakra* is stated, generally, to have been derived from *Shambhala,* as it is called in Sanscrit, (in Tibetan "*b*dé-*h*byung," vulgò "dè-jung," signifying "origin or source of happiness,") a fabulous country in the north, the capital of which was *Cálapa,* a very splendid city, the residence of many illustrious kings of *Shambhala,* situated between about 45° and 50° north latitude, beyond the *Sita* or Jaxartes, where the increase of the days from the vernal equinox till the summer solstice amounted to 12 Indian hours, or 4 hours, 48 minutes, European reckoning.

The *Kála-Chakra* was introduced into Central India in the last half of the tenth century after Christ, and afterwards, viâ Cashmír, it found its way into Tibet; where, in the fourteenth, fifteenth, and sixteenth centuries, several learned men, whose works are still extant in that country, published researches and commentaries on the *Kála-Chakra* system; among these authors the most celebrated are Puton, or Bu-stom, Khetup, or *m*Khas-grub and Padma Carpo, who lived respectively in the three centuries above-mentioned.

Padma Carpo (on the 68th leaf of his "Origin of (the Buddhistic) religion" *h*Chhos-*h*byung (vulgò "Ch'os-jung," consisting of 189 leaves,) thus describes the introduction of the *Kála-Chakra* into, or at, *Nalanda* (or *Nalendra,* a large religious establishment in Central India), and the doctrine which it contained:

"He (a certain pandit called Tsilu or Chilu) then came to *Nalanda* in Central India, (S. *Madhyam,* Tib. *d*vus, or vulgò U.) Having designed over the door of the *Bihar* the ten guardians (of the world), he wrote below them thus:

" He, that does not know the chief first Buddha, *(Adi-Buddha)*, knows not the *circle of time.* *(Kála-Chakra,* dus-kyi *h*khor-lo, in Tibetan*.)

He, that does not know the circle of time, knows not the exact enumeration of the divine attributes.

He, that does not know the exact enumeration of the divine attributes, knows not the supreme intelligence (S. *Vajra dhara jnyána,* Tib. *r*do-*r*jé *h*dsin-pahi yé-shes.)

He, that does not know the supreme intelligence, knows not the Tantrica principles *(Tantra Yánam.)*

He, that does not know the Tantriká principles, and all such, are wanderers in the orb of transmigrations, and are out of the way (or path) of the supreme triumphator (S. *Bhagaván Vajra dhara,* Tib. *b*,chom-*l*dan-*h*das *r*do-*r*je *h*dsin-pa.)

" Therefore, *Adi-Buddha* (Tib. mchhog-gi dang-pohi Sangs-*r*gyas) must be taught by every true *b*Láma (S. *Guru,* a superior teacher, religious guide), and every true disciple who aspires to liberation (or emancipation) must hear them." Thus wrote he:

" The venerable (the lord) NÁROTAPA (NAROTTAMA?) being at that time the principal (S. *Upádhyaya,* Tib. *m*khan-po) of the *Bihar;* he, together with five hundred pandits, disputed with him, but when they saw that he excelled them all in disputing, they fell down at his feet, and heard of him *Adi-Buddha;* then this doctrine was much propagated."—See leaf 68, by PÁDMA CÁRPO.

Here follows the text of the above quoted passage by PA'DMA CA'RPO, both in the Tibetan and Roman characters.

* The *Kála-Chakra* and *Adi-Buddha* systems are probably the same with that of the Samanians in the north, in Transoxana, and beyond the Jaxartes, as it has been described by M. Deguignes, in his " Histoire Générale des Huns," Livre III. p. 223, &c., recently criticised by M. Remusat; since the doctrine of the Samanians is exactly the same, as I have found in the Tibetan volumes.—Besides the mystical theology and philosophy, there are in the *Kála-Chakra* system several works on astronomy, astrology, and prophetical stories on the rise, progress, and decline of the Muhammedan faith.—In the *b*stan-*h*gyur collection (of 225 volumes) the five first volumes contain fifty-two tracts or treatises on the *Kála-Chakra,* all translated from the Sanscrit; but, besides these, there are many other volumes written by Tibetan authors on the same subject. In the Asiatic Society's library, there are also some printed volumes, containing commentaries on the *Kála-Chakra,* by Khétup or more properly *m*Khas-grub, mentioned in this paper as a very celebrated writer in the fifteenth century. Should I find any interesting article in it, I shall take occasion to notice it hereafter.

'དེ་ནས་དཔུས་ནས་པ་ནུ་ར་སྟོན། གཙུག་ལག་ཁང་གི་སྒོ
གོང་དུ་རྣམ་བཅུ་དབང་ལྡན་བྲིས། དེའི་གཞམ་དུ།
"གང་གིས་མཆོག་གི་དང་པོའི་སངས་རྒྱས་མི་ཤེས་པ
དེས་ནི་དུས་ཀྱི་འཁོར་ལོ་མི་ཤེས་སོ།། གང་གིས
དུས་ཀྱི་འཁོར་ལོ་མི་ཤེས་པ་དེས་ནི་མཚན་ཡང་དག
པར་བརྗོད་པ་མི་ཤེས་སོ།། གང་གིས་མཚན་ཡང
དག་པར་བརྗོད་པ་མི་ཤེས་པ་དེས་རྡོ་རྗེ་འཛིན་པའི
ཡེ་ཤེས་ཀྱི་སྐུ་མི་ཤེས་སོ།། གང་གིས་རྡོ་རྗེ
འཛིན་པའི་ཡེ་ཤེས་ཀྱི་སྐུ་མི་ཤེས་པ་དེས་སྔགས་ཀྱི
ཐེག་པ་མི་ཤེས་སོ།། གང་གིས་སྔགས་ཀྱི་ཐེག་པ
མི་ཤེས་པ་དེ་ཐམས་ཅད་ནི་འཁོར་བ་པ་སྟེ་བཅོམ
ལྡན་འདས་རྡོ་རྗེ་འཛིན་པའི་ལམ་དང་བྲལ་བའོ།།
དེ་ལྟ་བས་ན་མཆོག་གི་དང་པོའི་སངས་རྒྱས་ནི་བླ
མ་དམ་པ་རྣམས་ཀྱིས་བསྟན་པར་བྱ་ཞིང་། ཐར་པ
དོན་དུ་གཉེར་བའི་སློབ་མ་དམ་པ་རྣམས་ཀྱིས
མཉན་པར་བྱའོ་ཞེས་གྲགས་པ།" ཇོ་བོ་ན་རོ་ཏ་པ
དེ་དུས་དེའི་མཁན་པོ་ཡིན་པས། དེ་ལ་སོགས་པ་པཎྜི་ཏ་ལྔ
བརྒྱ་བཅད་པས་ཡུལ་དུ་ཕྱིན་པར་མཐོང་ནས་ཞབས་ལ
བཏུད་དེ་དང་པོའི་སངས་རྒྱས་ཉན་པས་ཆེར་དར་བར
གྱུར་པ་ཡིན་ནོ།།'

J. B. Tassin lith.

Dé nas *dv*us *Nalandar* byon, *g*tsug-lag khang-gi *s*go gong-du *r*nam-pa *b*chu *d*vang *l*dan bris, déhi *g*sham-du : " Gang-gis *m*chhog-gi dang-pohi Sangs-*r*gyas mi-shes-pa dés ni dus-kyi *h*khor-lo mi-shes so; Gang-gis dus-kyi *h*khor-lo mi-shes-pa dés ni *m*tshan yang-dag-par *br*jod-pa mi-shes-so; Gang-gis *m*tshan yang-dag-par *br*jod-pa mi-shes-pa dés *r*do-*r*jé *h*dsin-pahi-yé-shes-kyi sku-mi-shesso; Gang-gis *r*do-rjé *h*dsin-pahi yé-shes-kyi *s*ku mi-shes-pa dés *s*nags-kyi thég-pa mi-shes-so; Gang-gis *s*nags-kyi thég-pa mishes-pa déthams-chad ni *h*khor-va-pa sté *b*chom-*l*dan-*h*das *r*do-*r*je *h*dsin-pahi, lam dang bral-vaho. Dé-lta-vas-na *m*chhog-gi dang-pohi Sangs-*r*gyas ni *b*Lámá dam-pa-*r*nams-kyis *bs*tan-par-bya-zhing, thar-pa don-du *g*nyér-vahi *s*lob-ma dam-pa-*r*nams-kyis *m*nyan-par-byaho," zhes bris-pa.

Jovo Nárotapa dé dus déhi *m*khan-po yin-pas, dé la sogs-pa Pandita *l*na *br*gyas *br*tsad-pas phul-du phyin-par *m*thong-nas zhabs-la *b*tud-dé dang-pohi Sangs *r*gyas nyan-pas chhér dar-var gyur-pa yin-no.

No mention is made of the *Kála-Chakra,* nor of *Adi-Buddha,* by ancient writers in India, till the 10th century, except in the first volume of the *r*Gyut class in the Kah-gyur, where it is evidently an interpolation from true historical works of later ages.

Since the passage above exhibited is an authentic text for the name of *Adi-Buddha,* while it furnishes a general idea of the *Kála-Chakra* system, I have thought proper to bring it to the notice of the Society, and hope it will be of some interest.

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## II.—*Journal of a March from Ava to Kendat, on the Khyendwen River, performed in* 1831, *by* D. Richardson, *Esq. Assistant Surgeon of the Madras Establishment, under the orders of Major H. Burney, the Resident at Ava.*

20th January, time 5 h. 20 m. distance 10 miles; direction N. 40° W.; at noon, started from Ava; 12 h. 25 m. crossed the river, which, with waiting on the northern bank for two horses and some coolies from the *Myo Woon* of *Tsa-gain,* detained us till 2 h. 45 m. when we again proceeded, and at 3 h. 25 m. passed *Pa-be-dan,* or Blacksmith's Village, of from seventy to one hundred houses, all inhabited by blacksmiths from *Tsa-gain,* (the city on the northern bank of the river opposite to Ava:) to this place the houses are nearly continuous. At 3 h. 35 m. pass *Kyouk-tsheet,* nearly the same number of houses; the inhabitants employed in making marble images for the pagodas, and other religious edifices. At 4 h. pass *Magee-tzen,* a village nearly the same size as the others: about 4 h. 30 m. pass within a furlong east of the *Koung-mhoo-dau-gyee* pagoda, to the S. W. of which, about half a mile, is a swamp of some extent, and to the east of it, and of the road, another, called *Ye-k,ha,* the waters of which are extremely bitter. 5 h. 20 m. halt at *Tsa-ye,* a large village; the road throughout the day has been level and good: about two and a quarter miles west from the foot of the *Tsa-gain* hills;—the soil light and sandy: nearly the whole country, on both sides of the road, has been under cultivation, and the *cholum** and paddy stubble is now covered with many hundred black cattle, in high condition. No *Tès* had been built for us here, though orders to that effect had been issued by the *Lhwot-tau* many days.

21st. Time 3 h. 5 m., distance nine miles; direction N. 20° W.; 9 A. M. leave *Tsa-ye;* 9 h. 30 m. pass through *Padoo,* a large village, perhaps 160 houses. 12 h. 5 m. halt at *Kek-ka,* about 90 houses (in the *Zarat);* appearance of the country much the same as the latter part of yesterday's march. Cattle numerous, water sufficient, and cultivation extensive, but slovenly in most places, with the exception of the spots where grain is sown, which is about a foot high, green and vigorous, and the fields well cleared: the jungle has been only partially grubbed out, and the paddy, sesamum, and *cholum* sown amongst the remainder. The road to-day level, and still light and sandy, has run along a plain, between the *Tsa-gain* hills to the eastward, running about N. 20° W. distant three miles, and a ridge of elevated ground to the westward, running nearly in the same direction, distant about eight miles. Great part of this plain is, and the whole might be, brought under cultivation.

22nd. Time 7 h. distance 21 miles, direction N. 20° W.; 8 A. M. leave *Kek-ka;*—8 h. 50 m. pass *Thughe,* a small village, perhaps 20 houses:—9 h. 20 m. pass *Pay Thughe,* about 60 houses:—9 h. 45 m. pass *Oun-ngay-bouk,* about 70 houses:—10 h. 20 m. *Kamday,* small village; in the palmyra tope, preparing to make sugar:—11 h. 10 m. *En-bay taung-cong;*—11 h. 40 m. *En-bay,* rather a large village:—1 h. 20 m. *They-yoin,* small village, some remarkable pagodas:—3 h. 8 m. halt at *He-len,* large village, about 150 houses. The road light sandy, as before, as far as *They-yoin,* from which commences a rich loamy clay, and the crops of grain seem from the stubble to have been heavier. The range of hills, to the westward of which we have been marching, terminated at *Kek-ka,* and exposed to view a second range somewhat higher than the first; the highest called *Seew-koo-taung,* perhaps 1500 or 2000 feet, bounding the Shan country, running nearly in the same direction

* Burmese, *Pyoung;* I am told the whole country from this to Mouxobo is under water in July, August, and September.

(N. 20° W.) and distant from the road perhaps 15 or 20 miles. After leaving *En-bay,* up to which place the cultivation of all the common grain of this country was almost uninterrupted, with large and numerous herds of cattle and villages at short distances,—the horizon to the westward was bounded by apparently a thin strip of palmyra trees, running some way north, then coming round to the eastward, increasing in numbers, crossing the road, and running on towards the hills; immediately within these, to the westward, is a grassy, apparently marshy, plain of some miles, and immediately on the borders of this, about quarter of a mile from the road, small clusters of huts called *Tsha-doun,* from the occupation of their inhabitants, who are salt-makers; and between these and the road, the paddy grounds, from which the salt is also obtained, continue to *He-len.*

23rd. Time 8 h. distance 22 miles; direction N. 40° W.; 8 A. M. leave *He-len,* immediately after which, cross for a few minutes some high broken ground, at the foot of which cross some marshy grounds in the salt fields; at 8 h. 30 m. the paddy fields and cattle of the village;—9 h. 30 m. grassy plain with open jungle; 9 h. 45 m. jungle closer:—10 h. pass a small village of 10 or 12 houses, called *Tha-men-khyet-tshain,* or cooked-rice shop, where three people may dine well for $\frac{1}{4}$ of a tikal; the inhabitants of this place belong to *Mout-tsho-bo,* and come out here, and to some other villages of the same name in this neighbourhood in the fine monsoon, to keep these shops;—10 h. 30 m. a small village or salt station with its paddy ground and cattle; 11 h. 50 m. arrive at *Mout-tsho-bo,* famous as the birthplace of Alompra, a walled city of two miles square: the walls principally of bricks, partly of a kind of slate, are still in pretty good repair, though the city was at one time, since Alompra, entirely abandoned, and has only of late years been re-occupied; it is said to contain 1000 houses, which I should think rather under than over the true estimate, though there are extensive paddy fields, (amongst which many of the descendants of Alompra are living by their labor) to the northward and westward, between the inner brick walls and the outer wall, or earthen mound, round which is the ditch. To the southward, there is no earthen wall, and the ditch is close to the brick walls. The inner small fort or rather palace enclosure (for it is without flanking defences of any sort, as indeed, is the large one to any extent), is entirely without inhabitants. The old palace nearly all down, and overgrown with long grass and creepers; it must have always been confined, as the *Lhwot-tau* and platform for the gong for striking the hours are divided from it, within the same enclosure, by a brick wall. The large pagoda called *Shwe-ta-za,* or *Nae wadi see* *thoo Koung-mhoo-dau*, is of considerable size, but no gilding is now visible on it. 12 h. 20 m. start, and at 1 h. 25 m. pass out of the *Kathee* gate of the outer wall; the ditch, which on the south side is empty, and might be crossed without notice, is here in tolerable repair, and between the gateways to the right, full of water*. 2 h. 35 m. a small village (*Thamen-khyet-tshain)*. 3 h. pass *Ka-daun*, a village of 50 or 60 houses : at four, halt at *Kya-yowa*, a village of about 200 houses. The first part of to-day's march has been less under cultivation than the same distance during any former part of the route from *Mout-tsho-bo*; hitherto it has been almost continued: cattle and water abundant, the road good throughout: the eastward hills have been visible all day, but extremely distant in the afternoon: no high land visible to the westward, many of the villages surrounded with cocoanut trees, and the palmyra numerous throughout, notwithstanding the extensive production of salt. For the last two days, I have not tasted any water at all brackish. Of the salt, three different kinds are obtained—the red, the bitter (probably containing a portion of sulphate of magnesia), and the white; the two former are entirely used in making *Gna-pee* or *Balachong*; the latter only is good and fit for culinary purposes.

24th. Time 7 h. 10 m. distance 19 miles,—direction N. 65° W. 8 A. M. leave *Kya-yowa*; 9 h. 15 m. pass the second *Kya-yowa*, of which there are three established by Bundoola when he was Myo Woon of *Debay-en*, and governor of the northern provinces: to pass a small grassy lake, and the third *Kya-yowa*;—10 h. 30 m. pass *Men-daun*. In the jungle to the north of this, which is scantily inhabited, there is a herd of 50 or 60 elephants, which are exceedingly destructive to the crops in this neighbourhood. 12 h. 45 m. came on the banks of the *Moo* river now easily fordable on horseback, but of much greater extent and depth in the rains. There are now two streams of nearly equal size, with an extent of perhaps 100 yards of land between; the whole from bank to bank cannot be less than 400 yards. Crossing which river and waiting at *Ye-oo*, a large village on the western bank, for some fresh horses, detained us till 2 h. 5 m. and at 3 h. 15 m. halt at *Pha-lan-goun*. Paid my respects in the evening to the *Debay-en* Myo Woon, (a relation of the Queen's,) who is a *Men-gyee*, and in addition to his Myo Woonship, also governs the northern provinces: he is a man of about 45 years of age, of intelligent and rather prepossessing appearance; he was engaged in the usual important duty of witnessing a *pwè* (or natch) on the occasion of calling *Thadoo*

* I was told that the ditch could at any time be filled from the *Kan-dau-gyee*, or great royal lake, which lies about two or three miles to the N. E.

to a new pagoda, many of which edifices and some magnificently gilded, with *Phoun-gyee* houses and tanks attached, have been constructed by him, and his predecessor, proclaiming the richness of his government.

The hills to the northward were visible till noon, since which I had not seen them: inhabitants, cattle, cultivation, and water, plentiful; and the roads good for any description of carriage at this season.

25th. Halt at *Pha-lan-goun*, which is a large scattered village of probably 150* houses; the governor of the northern provinces has now his residence here. The city of *Debay-en*, from which he takes his title, is situated about six miles to the south-westward; it is nearly depopulated, and the walls entirely out of repair. He (Myo Woon) furnishes from his government (which extends now, since the removal of the Myo Woon of *Mout-tsho-bo* from the *Tsa-gain* territory, to the *Khyendwen)*, 3600 soldiers and six *bős* or officers. 300 of them have been exercising with muskets last evening and to-day, assisted by some natives of British India, six of whom left Ava three months ago, receiving 25 tikals each; they say, they have been drilling recruits to the northward, and are now about to return to Ava.

Grain is here plentiful, and tolerably cheap; paddy sells at from 15 to 20 tikals per 100 baskets; *cholum*, 10 tikals per 100 baskets, and the sesamum oil $\frac{1}{4}$ tikal the *vis*, and palm sugar (a large quantity of which is made here, and sent to the other parts of the country, even exported at Rangoon; the season for entering on the manufactory commences the end of next month), I understand it sells for 15 tikals the 100 *vis*. Though cattle are so plentiful here, I am told that as much as 80 tikals is sometimes given for a good caste bullock, with the proper marks; but cows and the common bullocks sell from 5 to 8, or 10 tikals; and for common draught cattle, from 10 to 15. Got some coolies and horses here.

26th. Time 4 h. distance 12 miles; direction N. 60° W. left *Pha-lan-goun* at 8 h. 55 m. P. M. Pass *Sedi Mee*, a village of 30 houses;—9 h. 25 m. *Way They*, of the same size;—10 h. 10. m. *Yowatheet*, about 100 houses, which is called *Yowama*, or chief village, from which many little nameless villages in this neighbourhood are offsets.—11 h. 25 m. cross a small nala, and 8 h. 12 m. halt at *Myago*. The whole march to-day has been one uninterrupted sheet of cultivation; the soil, rich clayey loam, the crops heavy and close, and the whole country studded with palm trees, round which the paddy is sown with no more loss of room than the size of their trunks. The trees most numerous in the jungle are the *Theet-tse*, which were in full flower on my return on the 19th February.

* I discovered on my return that I had considerably underrated the population of this part of the country.

27th. Time 9 h. 15 m. distance 25 miles,—direction N. 80° W.; 7 h. 35 m. leave *Myagoo;* at 8 h. pass a small village, where sugar is made; 9 h. 30 m. another small village, of 5 or 6 houses,—small stream. 12 h. cross the wide bed of a nameless mountain stream, in which the stream of water at this season is not ankle-deep; from this there is a slight gradual ascent;—at 4 h. pass the village *Yowa-ngay,* 20 houses; 4 h. 50 m. halt at *Benthee* in the jungle. No village, and very little water; the road has been as good as usual, but entirely in the jungle. Since 9 h. 30 m. with the exception of the little village of *Yowa-ngay**, we have seen neither inhabitants, cultivation, nor cattle, and the palmyra has entirely disappeared; the jungle has been open, principally composed of *En*† trees; some teaks of fair size, and a great number of *Theet-tse* trees.

28th. Time 6 h. 30 m. distance 19 miles; direction S. 60° W. 7 h. 30 m. leave *Benthee;* 8 h. 15 m. pass the end of a deep ravine, running N. from the road. Since noon, yesterday, have been ascending;—now (8 h. 45 m.) descend‡ into the broad bed of a river (without a name), along which in deep sand, the road runs all the way to *Thoun-bouk,* when it falls into the *Khyendwen,* and along which a small stream of water finds its way, occasionally on the surface, occasionally lost in the sand; the banks, which are of soft sandstone, vary from 20 to 100 feet, often perpendicular; sometimes on both, sometimes only on one side of the river, the other being low, covered with jungle, as the high banks are to their edges. In width the river varies from 40 to 120 yards, or more; and in the sand are many larger rolled masses of granite and sienite; but I saw no other rock in situ but the argillaceous sandstone, of which the whole of the bank is composed, and which is in a state of decomposition wherever it is exposed to the action of the atmosphere. 11 h. *Kimdogue,* a small village, with 10 or 12 houses, some cattle, baffaloes, and cultivation about it; there is a ravine, running away to the N. W. and a small stream comes down from the westward, running apparently in much the same description of bed as that down which we have come, which joins here; and the ground is more

* This is the only village left of several very large ones, which were situated here, and were destroyed by robbers before Bundoola, who immediately preceded the present governor, was appointed to this province; they came from Lado, about 11 miles S. E. of *Moutshobo.* Their chiefs, wearing gold chattahs, ransacked the country sometimes with 2000 followers. Bundoola however cleared the country, which has remained quiet since, and travelling now is perfectly safe.

† A large forest tree; the timber of which is used in boat-building, and the leaves in the thatching of houses where grass is scarce.

‡ All the streams to the eastward fall into the *Moo,* those to the westward into the *Khyendwen.*

swampy (with long grass) than any part of the country since leaving Ava; the road is however still very passable for any common carriage: 1 P. M. low range of hills, S. 70° W. distant six miles, running S. 20° bed of the river, which is now a continued stream, and march along its banks till two :—halt at *Thoun-bouk*, a village of about 20 or 30 houses on the E.; leave the banks of the *Khyen-dwen*. The road we have come to-day is the only one by which communication is held with the capital, even in the rains, though the torrent is so impetuous during and immediately after heavy rain as not to be fordable, yet it soon runs off and never sends a continued body of water into the *Khyen-dwen* for any length of time.

29th. Time 4 h. 15 m. distance 12 miles, direction about N. 75° W. 8 h. 30 m. send the baggage by the river, by which greater part of the communication to the N. W. is carried on; we leave *Thoun-bouk;* for a few minutes we travel through a thick jungle, then ascend a low but steep hill, down the descent of which we are obliged to dismount and lead the horses. At 9 h. 10 m. in sight of the *Khyen-dwen*, and proceed along the broad bed of a mountain torrent in deep white sand, with high perpendicular banks running off in ridges from the stream :— 9 h. 35 m. enter the jungle, and immediately ascend another hill; pass along a narrow ridge, and descent very steep; continue crossing steep ridges of low sandy hills, covered with jungle, and winding amongst them in the dry beds of torrents, till 12 h. 15 m. when we pass a small village in a cultivated plain :—12 h. 30 m. cross a small stream about knee-deep, in which the horses suddenly sink up to their girths in the sand, and we are obliged to dismount, to allow them to extricate themselves; they crossed with some difficulty. 12 h. 45 m. at *Mouk-ka-dau*, a village of perhaps 80 or 100 houses, close to the banks of the *Khyen-dwen*. About one day to the north of our march to-day, are a considerable number of cassia trees. In the bed of most of the streams and on many of the hills also, saw numerous (calcareous) woody petrifactions, but could hear of no fossil organic remains in this neighbourhood; there are two pretty large boats on the stocks here, and teak timber of good size cut in the neighbourhood, ready for the construction of others.

30th. Time 6 h. 20 m. distance 17 miles; direction N. 30° W.; 7 h. 30 m. leave *Mouk-ka-dau*, and in a few minutes descend slightly into the valley of the stream in which the horses swamped yesterday :—pass along a bad and swampy road through paddy fields, into which the water has been turned for cultivation; cross and recross the stream till 9 h. 45 m. when we proceed up a small branch more to the westward, with high sandstone banks on the westward and jungle on the eastward side, along which we proceed till 11 h. 25 m. when the water is lost in the sand; halt till 12; then to *Pa-doo-yee,* where we halt at 3 h. 15 m. in a small bamboo *Za-yat* in the jungle: the road has much the same character as yesterday, with the addition that some of the ravines close to the road have a considerable appearance of danger; both sides of the first stream, along which we passed till 9 h. 45 m., are well cultivated and inhabited, with many buffaloes and some black cattle. We followed the cart road of the valley till 11 h. 25 m. when we left it to the eastward; the jungle principally composed of *En* trees, with a considerable number of teak and *Theet-tse* trees: we have seen numerous marks of deer, wild hogs, and cows throughout the march; passed some small pieces of petrified wood, but not nearly so abundant as yesterday.

31st. Time 7 h. 45 m. distance 20 miles—direction N. 35° W. at 7 h. 45 m. A. M. leave *Pa-doo-ye,* and proceed along a jungle path in all respects the same as that we have followed for the last two days, till 4 P. M., when we pass some paddy fields with a few buffaloes belonging to the small village of *Balet,* which consists only of 4 or 5 houses, at which we halted at 4 h. 25 m. Some high hills to the westward of the *Khyen-dwen,* within a few miles of which this village is situated. One visible from this, bearing N. 80° W. distant 15 miles—direction of the range is about N. 10 W.

1st February. Time nine hours; distance 25 miles; direction N. 20° W.; were nearly losing some of the horses in the night by a tiger, which has done a good deal of mischief between this and the next stage; 5 h. 50 m. leave *Balet* by a sandy road, on the side of a small stream, with paddy fields along its banks, till 8 h. 30 m. when we halted at *Ma-tsen* to breakfast; had cold dew or fog all the morning, so heavy as to fall from the trees, as after a shower. We have had during the night ever since entering the jungle, and it will continue it is said till the beginning of the rains, which set in here about the middle or end of this month. 10 h. 25 m. leave *Ma-tsen,* by a pretty good buggy road along the edge of the stream we have followed from *Balet,* and which here runs in a valley of about a mile in width. This valley is nearly all under cultivation, with a good many black cattle and buffaloes; it is bounded on the west by a low range of hills, and to the east by high hills running off in ridges to the northward; the little villages in this valley go by the general name of *Ma-tsen,* and are said to amount in all to about 400 houses. 12 h. 30 m. leave the valley, and cross some steep, but low hills, by a rugged path, in rather thick jungle, till 1 h. 20 m.; pass a small village. From this to *Nanthee* the course of the river is exceedingly circuitous amongst low rugged hills, across which our path has lain : after passing three small villages, each in its little valley by the stream, which is here perhaps two and half feet deep, at 4 h. 45 m. halted at *Nanthee,* a village, 40 or 50 houses, with extensive paddy fields, many black cattle, and a few horses.

2nd. Time 5 h. 40 m.; distance 16 miles ; direction N. 20° E. 7 h. 50 m., leave *Nanthee,* and proceed along the banks of the stream in a little valley, two or three miles in width, in which the *Nanthee* villages are scattered in the same way as were those of *Ma-tsen* yesterday ; road partly good, till 9 h. 30 m. when we entered the jungle, and the path assumes the same character as the jungle of the last few days, from 1 h. 30 m. till 2 h. 30 m. when we halted at *Kendat :* the road is level, and the country open and cultivated to the N. W. as far as the *Khyen-dwen* river ; immediately on the western side of which, distant about six miles, the rugged hills of the *Manipúr* territory rise to some height, and run away in confused and broken ranges to the N. E. close to the edge of the river. *Kendat,* the present residence of the Khambat or Kendat Woon, (for the former title is still given him by the Burmans, though the town from which he takes it, is at present subject to *Manipúr ;)* is a long, narrow jungle-wood stockade close to the east bank of the river, containing perhaps 12 or 1400 inhabitants, situated in a long narrow swampy valley, lying along the river, about 15 or 20 miles in length and averaging one-half or two miles in width, with a strip of swampy ground, which appears at one time to have formed the bed of the river running to the eastward of it. The number of cattle is smaller in proportion to the number of inhabitants than in the villages nearer the capital. Bad as the road is from *Thoun-bouk* to this, I am assured, that ALOMPRA once travelled it in a carriage ! and that it is the best, perhaps the only one by which any number of people ever come in this direction, I have little doubt. It is called by all the poor people in the villages, who cannot be suspected of any motive to deceive, and who could not have been warned to do so, *Lan-ma-dau-gyee,* or great royal road (king's high way), and is I dare say very passable to a Burmese army, who have no commissariat, and whose artillery is not the most extensive, and is often moved by manual labor, assisted by elephants.

10th. Waiting to this date for the arrival of Captain Grant from *Manipúr,* who joined me this evening ; have seen a good deal of the Kambat Woon, since my arrival here ; he tells me the *Payen-dwen* or amber mine, so called, is in the bed of this river, about 40 days from this place ; but that the amber is found most abundant, about four miles inland, on the eastern side of the river, where it is obtained in pieces sometimes one and a half foot or more in length, and images of Godama are formed of it; its price increases with its size and transparency, but good amber may be bought on the spot for one tikal and a half a viss, and I am assured that the best would not cost five tikals.

The principal deposit of coal, which is found here in large quantities, in the bed of the river, is about 12 or 14 miles above this, in the small valleys, on both sides of the river. It is of that species denominated lignite, and some of it is so highly bituminized as to be converted into jet. In some specimens, whilst the outside contains this large proportion of bitumen, internally there is very little; the longitudinal fracture is dull, the woody structure perfect, and some of the fibres retain slight elasticity; the transverse fracture has in all instances some degree of lustre in situ; it is formed in sand, and soft sandstone rock, in large pieces, retaining the form of the trees, from which it was originally formed: the Burmans say it is useless as fuel, going out unless used with a large quantity of wood.*

17th. Having been provided by the Khambat Woon with three boats, we started this day at noon, on our return to Ava. The river which runs here to the southward and westward is wide, probably 600 yards; but the water is at this season confined to a narrow channel on the western side. In 1829, the river rose higher than has been remembered here, and the same was the case with the *Me-ping*, and rivers in north *Laos*, where a good deal of damage was done, and the crops, in many places, totally destroyed. Six P. M. halt at *Matsein*, the largest of the villages of that name; the river has been very circuitous throughout the day; the banks generally high sandstone hills, covered with jungle to the water, which is so shallow, where it extends nearly across the bed of the river, that the boat has grounded once or twice; the villages four in number, generally small; no cultivation visible on the immediate banks of the river.

18th. Seven h. 20 m. A. M. leave *Mat-sein*, and at 6 h. 30 m. P. M. halt at *Oo-yowa;* passed eight villages on our route to-day, some of them (as *Kea-dzet*, which we passed at nine o'clock,) larger than any of those we passed yesterday; at 11 h. 40 m. a small river falls into this from the north-eastward, which the people in my boat say is the *Myéet-tha*. The nature of the country has been nearly the same as yesterday, viz. high hills, often nearly perpendicular towards the river; covered with jungle, till 3 P. M.; since which the hills have retired from the river, and the country has been more level, but covered with jungle; we have passed a good many fishing stakes, and several parties of fishermen hutted on the sands.

* Vide GLEANINGS IN SCIENCE, III. 125.

19th. Seven h. 15 m. leave *Oo*;—10 h. 30 m. the river gives off a branch nearly as wide as the main stream. 10 h. 45 m. pass the city of *Men-gen,* about 150 houses with gardens, tastefully dispersed along the banks of the river: where also are the boats of the village, (for a village it is now,) amounting to about 100 or upwards, many of them good sized. 12 h. 20 m. the branch mentioned at 10 h. 30 m. here rejoined the main stream. 3 h. 35 m. *Mouk-ka-dau,* and at 5 h. halt at *Thoun-bouk,* where the horses had arrived about a quarter of an hour before us; we passed six villages to-day, including *Men-gen* and *Mouk-ka-dau;* all small, but the two named; the course of the river was very circuitous, and the hills (which are of sandstone, soft and friable at the upper part and more compact near the bottom) again close to it, but to-day frequently only on one side, the other being level.

20th. From this we returned by the same route we travelled in the way up, making longer marches, and reached Ava in six days. We had heavy rain the first three marches, from which the people look on the rains as set in, and are in many places preparing the ground for the paddy. The last three days, however, it cleared up again, and the sun was exceedingly powerful till our arrival at Ava, where we halted on the 25th, at noon.

Should it ever be necessary to move a force across this part of the country, the way in which I have returned is the only practicable one. From *Ken-dat* to *Thoun-bouk,* the road is impassable for all sorts of carriage, but boats may be had on the river: from *Thoun-bouk* to Ava the road is good; water, cattle, grain, every necessary in greatest abundance.

It may be worthy of remark here, as a little clue to the feelings of the people towards us, that I was very well received by the Debayen and Kambat Woons; that after the third day's march, *tès* or little temporary houses were invariably erected for us as had been ordered by the Woon-gyees, and the people voluntarily appeared to pay us more attention in proportion as we receded from the capital. On my return, the lower orders were universally anxious to learn the result of my Mission, with the object of which they all appeared acquainted; and on being told that every thing was quiet and right, I was always greeted by the exclamation of "*thadoo,*" "*thadoo**," (counting beads at the same time)—an expression which entitles the person making it to a portion of the merit arising from a good work, whilst it increases, or at all events does not diminish that accruing to the performer of it.

* A term of approbation in Burmese, "well done—that is right."

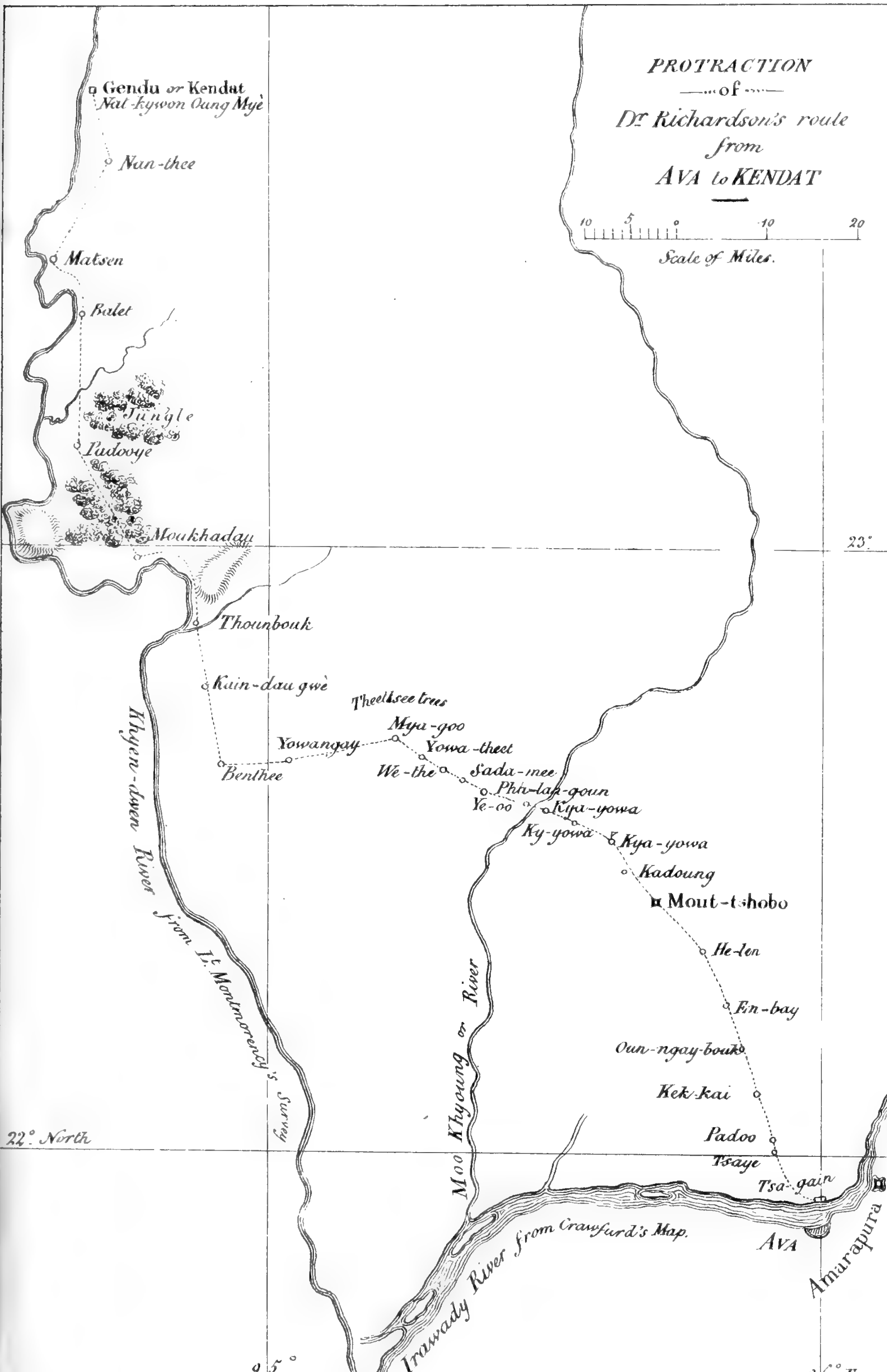
### *Remarks on the Route Protraction, Pl.* V.

The *Irrawaddy* and *Moo* rivers, in this sketch, have been copied from the Map of Ava in Mr. Crawford's Mission, and the *Khyen-dwen* river from Lieutenant Montmorency's Survey, as given in Lieutenant Wilcox's Map of the countries to the E. and N. E. of Bengal. The position of *Kendat* and *Mouk-ka-dau,* as well as of Ava, being fixed according to the above authorities, an attempt has been made to lay down Mr. Richardson's route, so as to correspond with those points. The following table will show the direction and distance travelled on each day, as computed by Dr. Richardson, and the corrections, on account of the windings of the road, and alterations made in order to reconcile his route with the situation of *Mouk-ka-dau* and *Kendat.*

| | | | Dr. Richardson's Computation. | | Correction and Alteration. |
|---|---|---|---|---|---|
| 1st day, | 20th Jan. | From Ava to Tsa-ye, | N. 40 W. 10 miles, | | N. 40 W. 8 miles |
| 2nd do. | 21st do... | To Kek-ka, ....... | N. 20 W. 9 do.... | | N. 20 W. 7 do. |
| 3rd do. | 22nd do.. | To He-len,........ | N. 20 W. 21 do.... | | N. 20 W. 16 do. |
| 4th do. | 23rd do... | To Kya-yowa,..... | N. 40 W. 22 do.... | | N. 40 W. 17 do. |
| 5th do. | 24th do... | To Pha-lan-goun,.. | N. 70 W. 19 do.... | | N. 70 W. 16 do. |
| 6th do. | 25th do... | To Mya-goo, ...... | N. 60 W. 12 do.... | | N. 60 W. 10½ do. |
| 7th do. | 26th do... | To Ben-thee, ...... | S. 80 W. 25 do.... | | S. 80 W. 20 do. |
| 8th do. | 27th do... | To Thoun-bouk,.... | S. 60 W. 19 do.... | | N. 10 W. 17 do. |
| 9th do. | 28th do. . | To Mouk-ka-da, .. | N. 80 W. 12 do. | over hills. | N. 40 W. 9 do. |
| 10th do. | 29th do... | To Padoo-ye, ..... | N. 30 W. 17 do. | | N. 30 W. 14½ do. |
| 11th do. | 30th do... | To Balet, ......... | N. 35 W. 20 do. | | N. 0 W. 15 do. |
| 12th do. | 31st do... | To Nan-thee, ...... | N. 20 E. 25 do. | | N. 15 E. 17 do. |
| 13th do. | 1st Feb. | To Ken-dat,....... | N. 10 W. 10 do.... | | N. 15 W. 9 do. |
| | | | Total, 221 miles. | | Total, 176 miles. |

The most important deviation from Dr. Richardson's computation was found necessary to be made, in the direction of the route from *Ben-thee* to *Thoun-bouk.* Captain Baker, who visited *Mont-tsho-bo* in 17 hours, 55 minutes, estimates Ava to be 45 miles distant, and states that he stopped and landed at *Khoun-meon, (Kyouk-myoung,)* on the Irrawaddy, and that this place is 12 miles due east from *Mout-tsho-bo.*—(Dalrymple's Oriental Repertory, vol. i. 147, 169, and 176.) *Kioum-young,* in Mr. Crawfurd's Map, is due east from the position given to *Mont-tsho-bo* in Dr. Richardson's route, which makes this city 40 miles from Ava. But it would appear, that the Irrawaddy, in this part of its course, must have a direction 14 miles more to the westward, than what is marked in former maps. *Dibayen,* Dr. R. learnt, is only six miles to the S. W. of *Pha-lan-goun,* and not so near to the Irrawaddy as before supposed. The situation of the great lake, or *Kan-dau-gyee,* also must be different. Dr. R. understood, that water can be let into the ditch of *Mout-tsho-bo* fort from that lake.

Dr. R. on his return from *Kendat,* came down the *Khyen-dwen* in a boat in three days to *Thoun-bouk,* and thence to Ava he travelled by the same route as before.




J. B. Tassin lith.

III.—*Trisection of an Angle.* *By* Col. Nasmyth Morrieson.

*Proposition* 1*st*, *Theorem.*

If, from the vertical angle of a triangle, having one of the angles at its base double of the other one, and the vertical angle greater than half a right angle, a straight line be drawn to cut the base, making an angle with the greater side of the triangle adjacent to the vertical angle, equal to the lesser angle at the base; and if from the vertical angle as a centre, at the distance of the lesser side of the triangle adjacent to the vertical angle, a circle be described; the circle, and the line drawn from the vertical angle to cut the base, and the base of the triangle, have one common intersection.

Let ABC (fig. 1) be a triangle, having the angle BAC, one of the angles at its base double of the angle BCA, the other angle at its base, and its vertical angle ABC greater than half a right angle; and let the straight line BD be drawn from the vertical angle ABC, to cut the base AC in D, making with CB, the greater side of the triangle adjacent to the vertical angle, the angle CBD equal to BCA, the lesser angle at the base (23.1); also from B as a centre at the distance BA, the lesser side of the triangle adjacent to the vertical angle, let the circle ADE be described; the circle ADE, the line BD, and the base AC intersect one another in one common point D.

Because, by construction, the angle DBC is equal to the angle DCB, the side BD is equal to the side CD (5.1), and D is the point of intersection of BD and AC. Again, because BDA, the exterior angle of the triangle BDC, is equal to the two interior and opposite (32.1) and also equal angles DBC, DCB, therefore, BDA is double of DCB, that is ACB; but, by construction, the angle BAC is double of ACB, therefore BAC is equal to BDA (6 ax); and because the angle BAC is equal to the angle BDA, the side BD is equal to the side BA (5.1); wherefore the circle ADE described from the centre B, at the distance BA passes through D, the extremity of BD, or D is the point of intersection of the circle ADE and the line BD; but it bas been already shewn that D is the point of intersection of BD and AC, consequently the circle ADE intersects, in the point D, the line AC; therefore the circle ADE, and the straight lines AC and BD intersect in one common point D. Q. E. D.

*Proposition* 2*nd*, *Problem.*

To draw the base of a triangle, so that, of the interior angles at the base, one shall be double of the other, the vertical angle of the triangle being a given rectilineal angle greater than half a right angle.

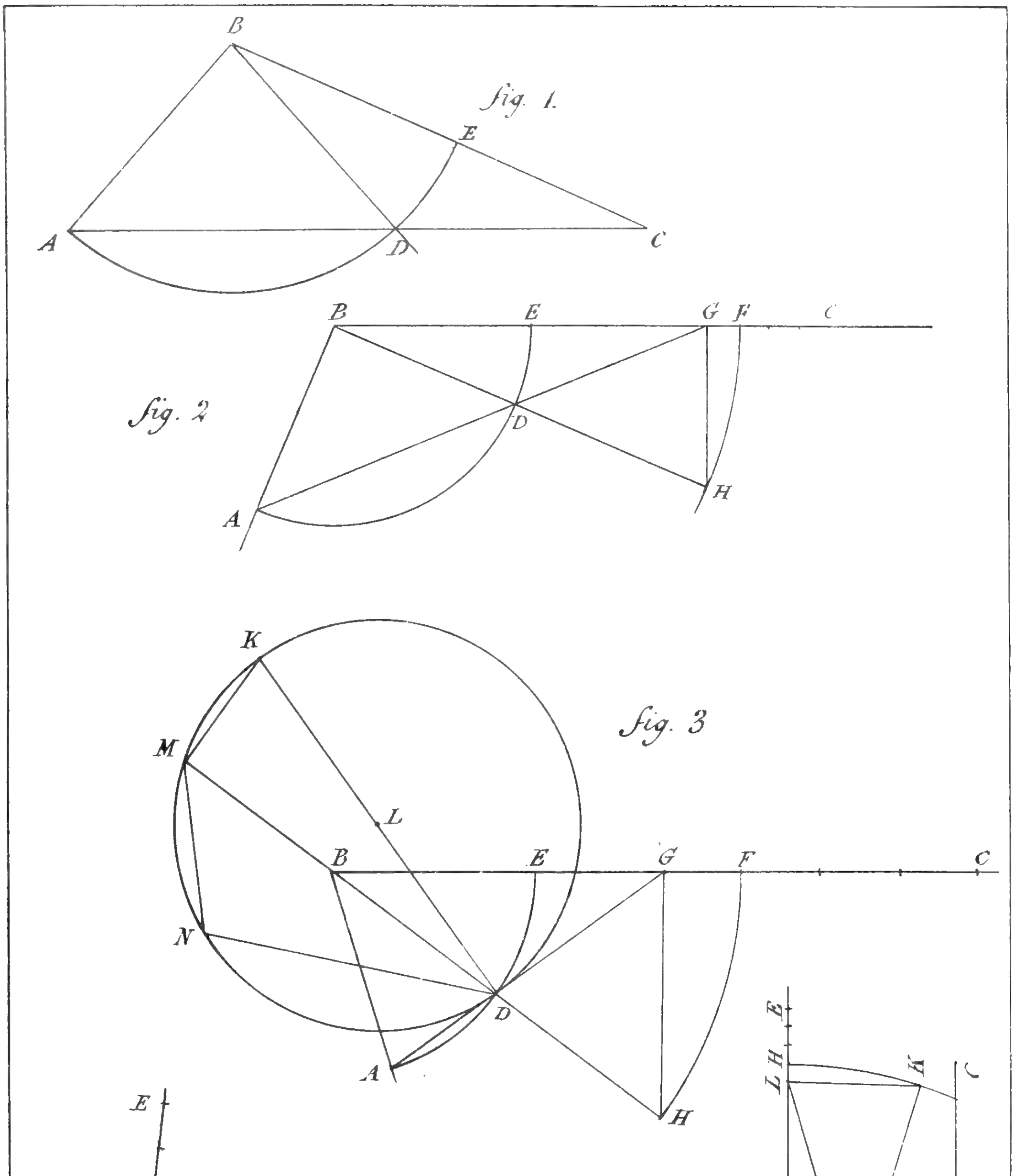
Let ABC (fig. 2) be any given rectilineal angle greater than half a right angle. Having placed it for the vertical angle of the triangle ABG, it is required to draw the base AG, so that of the interior angles it shall make with BA and BC, at the base of the triangle ABG, the one shall be double of the other.

From the centre B at any distance BA describe the circle ADE; again, from the centre B at twice the distance BA describe the arch of a circle FH, cutting BC, in F; also from the centre A at three times the distance BA, mark the point C in the line BC; divide the segment FC into three equal parts (9.6); make FG equal to one-third part of FC (3.1); through G draw GH at right angles to BC (11.1), meeting the arch FH in the point H; join BH and GA; the line GA is so drawn that BAG, one of the angles at the base of the triangle ABG, is double of BGA, the other angle at the base.

Because the two straight lines BH and AG and the circle ADE intersect in D, the two sides BD, BA of the triangle ABD, being radii of the circle ADE, are equal to one another (11.def.); also BH, which is equal to BF (11.def.) and double of BA or BD, is bisected in D; again, because BGH is a right angle subtended by BH, it is an angle in half the circle, having BH for its diameter and DB for its radius (31.3); and because GD joins the vertex of the right angle BGH and D, the point of bisection of the diameter, it is equal to DB (11.def.). Now because DG is equal to DB, the angle DBG is equal to the angle DGB (5.1); and they are the two interior and opposite angles to BDA, the exterior angle of the triangle BDG, therefore BDA is equal to them both (32.1), and double of either of them, that is, it is double of DGB; but the angle BAD is equal to the angle BDA, because BD is equal to BA (5.1), therefore BAD, that is BAG, is double of DGB, that is, AGB. Wherefore the base AG is drawn so that the angle BAG, one of the angles at the base of the triangle ABG, is double of BGA, the other angle at the base. Which was required to be done.

*Note.*—The truth of the above demonstration rests upon the straight lines BH and AG and the circle ADE having one common intersection; but as the circle and any two right lines have not of necessity one common intersection, it may *perhaps* be objected to, on the ground, that though it states the fact, it does not prove the intersection of the circle ADE and the right lines BH and AG in the common point D. To remove that objection, the following demonstration is given.

The construction being the same as above, instead of joining GA, proceed thus:—join BH, and let BH cut the circle ADE in the point D; join GD and DA; AD, DG are in the same straight line, and AG, the




J.B. Tassin lith.

base of the triangle ABG, is so drawn that BAG one of the angles at the base is double of BGA the other angle at the base.

AD and DG are in the same straight line; for through D draw DK, making the angles KDA, KDG equal to one another (9.1); take any point L in the line KD, and from the centre L at the distance LD describe the circle DNMK; if necessary, produce DB to meet the circle DNMK in M; join MK; and make the angle MND in the segment DNM of the circle DNMK. Now the angles KDG, KDA are either together, equal to, or greater, or less than two right angles; if greater, then KDG is greater than a right angle, and GD being produced in the direction of D, will fall within the circle DNMK on the opposite side of KD from DG (Cor. 16.3), which it does not, therefore KDG is not greater than a right angle: neither is it less than a right angle, for then DG would fall within the circle DNMK (16.3), which it does not; therefore KDG must be a right angle: and because at the point D the extremity of the diameter DK, DG makes a right angle with DK, therefore GD touches the circle DNMK (Cor. 16.3), and because DM, drawn from the point of contact D, cuts the circle DNMK, the angle MDG is equal to the angle DNM in the alternate segment MND (32.3). Again, because the angle KDA is equal to the angle KDG, it is a right angle, and also touches the circle KMND (Cor. 16.3); and because DM, drawn from the point of contact D, cuts the circle DNMK, the angle MDA is equal to the angle MKD (32.3); and because KDNM is a quadrilateral figure, described in a circle, the opposite angles MKD, DNM are equal to two right angles (22.3), therefore the angles MDG, MDA, being equal to the angles DNM, MKD are also equal to two right angles; and since at the point D, in the straight line MD or BD, the two straight lines DA, DG, upon the opposite sides of MD, make the adjacent angles MDA, MDG, equal to two right angles, AD is in the same straight line with DG (14.1): and the figure AGB being contained by three straight lines, is therefore a rectilineal triangle (16 def.) Now BD is equal to BA, being radii of the same circle ADE (11 def.), and because BH is a radius of the circle of which FH is an arch, it is equal to BF and double of BA or BD, and bisected in D by the circle ADE; also because BGH is a right angle, subtended by BH, it is an angle in half the circle, having BH for its diameter and DB for its radius (31.3); and because GD joins the vertex of the right angle BGH and D, the point of bisection of the diameter, it is equal to DB (11 def.) Now, because DG is equal to DB, the angle DBG is equal to the angle DGB (5.1), and they are the two interior and opposite angles to BDA, the exterior angle of the triangle BDG, therefore BDA is equal to them both (32.1), and double of either of them, that is, is double of DGB; but the angle BAD is equal to the angle BDA, because BD is equal to BA (5.1), therefore BAD, that is BAG, is double of DGB, that is, AGB. Wherefore the base AG is drawn so that the angle BAG, one of the angles at the base of the triangle ABG, is double of BGA, the other angle at the base. Which was required to be done.

*Proposition 3rd, Problem.*

To divide any given rectilineal angle into three equal angles.

Let ABC be any given rectilineal angle, it is required to divide it into three equal angles.

Consider whether the given angle is greater or less than three half right angles. First, let the angle ABC be less than three half right angles. Take any point D in AB, and through D draw DE, parallel to BC (31.1); then the angle BDE is the angle to be placed as the vertical angle of the triangle BDL; which having obtained, draw the line BL in the same manner as was done in the diagram for the foregoing proposition No. 2; and bisect the angle ABL by the straight line BO (9.1). The straight lines BL and BO divide the angle ABC into three equal angles.

Because DE is parallel to BC, and LB falls upon them, the angle DLB is equal to the angle LBC (29.1); and because the angle DBL is double of the angle DLB, as demonstrated in the 2nd proposition above written; therefore the angle DBL is double of the angle LBC; also because the angle DBL is bisected by the straight line BO, the three angles DBO, OBL, LBC are equal to one another.

Secondly. But if the given angle ABC be greater than three half right angles, bisect it by the straight line BN (9.1); and take any point D in AB, and through D draw DE, parallel to BN (31.1). Having thus got the vertical angle for the triangle BDL, viz. BDE, draw the line BL, as was done in the diagram for the foregoing proposition No. 2; and bisect the angle LBC by the straight line BO (9.1); the straight lines BL and BO divide the given angle ABC into three equal angles.

As before, because the angle DBL is double of the angle LBN, it is two thirds of the angle DBN; but because the angle DBN is one-half of the angle ABC, and that two-thirds of the half is one-third of any given whole, therefore DBL is one-third, and the remaining angle LBC is two-thirds of the whole angle ABC; and because the angle LBC is bisected by the straight line BO, the three angles ABL, LBO, OBC are equal to one another. Wherefore the given angle ABC is divided into three equal angles by the straight lines BL and BO. Which was required to be done.

## IV.—*Short Description of the Mines of Precious Stones, in the District of Kyat-pyen, in the Kingdom of Ava.*

[Translated from the original of PE'RE GIUSEPPE D'AMATO.]

The territory of *Kyat-pyen** (written *Chia-ppièn* by d'Amato) is situated to the east, and a little to the south of the town of *Mon-lhá*, (which latter place is by observation in latitude 22° 16′ North,) distant 30 or 40 Burman leagues, each league being 1000 *taa*, of seven cubits the *taa*†; say 70 miles. It is surrounded by nine mountains. The soil is uneven and full of marshes, which form seventeen small lakes, each having a particular name. It is this soil which is so rich in mineral treasures. It should be noticed, however, that the ground which remains dry is that alone which is mined, or perforated with the wells whence the precious stones are extracted. The mineral district is divided into 50 or 60 parts, which, beside the general name of " mine," have each a distinct appellation.

The miners, who work at the spot, dig square wells, to the depth of 15 or 20 cubits, and to prevent the wells from falling in, they prop them with perpendicular piles, four or three on each side of the square, according to the dimensions of the shaft, supported by cross pieces between the opposite piles.

When the whole is secure, the miner descends, and with his hands extracts the loose soil, digging in a horizontal direction. The gravelly ore is brought to the surface in a ratan basket raised by a cord, as water from a well. From this mass all the precious stones and any other minerals possessing value are picked out, and washed in the brooks descending from the neighbouring hills.

Besides the regular duty which the miners pay to the Prince, in kind, they are obliged to give up to him gratuitously all jewels of more than a certain size or of extraordinary value. Of this sort was the *tornallina* (tourmaline ?) presented by the Burman monarch to Colonel Symes. It was originally purchased clandestinely by the Chinese on the spot; the Burmese court, being apprized of the circumstance, instituted a strict search for the jewel, and the sellers, to hush up the affair, were obliged to buy it back at double price, and present it to the king.

* The *Kyat-pyen* mountains are doubtless the *Capelan* mountains mentioned as the locality of the ruby, in Phillip's Mineralogy—" 60 miles from *Pegue, a city in Ceylon.*" Though it might well have puzzled a geographer to identify them without the clue of their mineral riches.

† Estimating the cubit at 1½ feet, the league will be 10,500 feet, or nearly two miles ;—about an Indian *kos.*

You* may ask me, to what distance the miners carry their excavations? I reply, that ordinarily they continue perforating laterally, until the workmen from different mines meet one another. I asked the man who gave me this information, whether this did not endanger the falling in of the vaults, and consequent destruction of the workmen? but he replied, that there were very few instances of such accidents. Sometimes the miners are forced to abandon a level before working to day-light, by the oozing in of water, which floods the lower parts of the works.

The precious stones found in the mines of *Kyat-pyen,* generally speaking, are rubies, sapphires, topazes, and other crystals of the same family, (the *precious corundum.)* Emeralds are very rare, and of an inferior sort and value. They sometimes find, I am told, a species of diamond, but of bad quality†.

The Chinese and Tartar merchants come yearly to *Kyat-pyen,* to purchase precious stones and other minerals. They generally barter for them carpets, coloured cloths, cloves, nutmegs and other drugs. The natives of the country also pay yearly visits to the royal city of Ava, to sell the rough stones. I have avoided repeating any of the fabulous stories told by the Bnrmans of the origin of the jewels at *Kyat-pyen.*

There is another locality, a little to the north of this place, called *Mookop,* in which also abundant mines of the same precious gems occur.

*Note.*—While I am writing this brief notice, an anecdote is related to me by a person of the highest credit, regarding the discovery of two stones, or, to express myself better, of two masses (*amas*) of rubies of an extraordinary size, at *Kyat-pyen.* One weighed 80 *biches*‡, Burmese weight, equivalent to more than 80 lbs.! the second was of the same size as that given to Colonel Symes. When the people were about to convey them to the capital to present them to the king, a party of bandits attacked *Kyat-pyen* for the second time, and set the whole town on fire. Of the two jewels, the brigands only succeeded in carrying off the smaller one; but the larger one was injured by the flames: the centre of the stone, still in good order, was brought to the king. I learned this from a Christian soldier of my village of *Mon-lhá,* who was on guard at the palace when the bearer of the gem arrived there.

* The letter seems to have been intended for some scientific friend in Italy.

† Probably the *turmali* or transparent zircon, which is sold as an inferior diamond in Ceylon. [Vide vol. i. page 357.]

‡ The Père d'Amato's *biche* is the *bisse* of Mendez Pinto, and the old travellers, and the *biswa* or *vis* of Natives of India. The Burmese word is *Peik-tha,* which is equivalent to 3½ lbs., and to a weight on the Coast of Coromandel called *vis.* B.

V.—*Note on Saline Deposits in Hydrabad. By Assistant Surgeon* J. Malcolmson, *Madras European Regiment.*

From the interest which these possess, and the discussions they have excited, without any precise information as to their geological position, I believe the following notice will be interesting.

The summits of most of the detached hills and minor ranges north of *Cuddapah* are composed of a sand-stone, stratified in a perfectly horizontal manner. It is often white, and the grains are large; but towards *Tripetty*, where it meets the granite, it is very compact and white, and it is a good deal inclined to the east. The red soil of the district is loaded with salt, which is manufactured by the natives, principally for their cattle; but as it is prohibited by the Government on account of the revenue from the salt monopoly, it is seldom extensively worked in the districts I visited. The range of hills through which the *Benar* river passes at the ancient fortress of *Gundicottah* is formed of this sandstone; but inclined towards the east at a slight angle, and by no means regularly. This is separated by a narrow valley from hills exhibiting the horizontal strata on their caps, and the remains of these could be clearly traced on insulated conical hillocks, and had all belonged to one vast sheet. Below the sandstone caps, a clay slate, easily broken down, is found, and the lower strata over the country is a stratified blue limestone. In the slope of the hill of *Gundicottah* are springs of very pure water, very profuse, and forming small rivulets, tumbling over the rocks in fine cascades, but evidently deriving their source from no great distance, as in a day or two after the rain we had, the streams were much diminished where they emerged from between the strata. The *Benar* and these streams have formed cliffs round the fortress of 200 or 300 feet, all of sandstone, but at the very bottom, a deep ravine. I found one or two clay slate strata of about an inch thick interposed; and a few miles below, the blue limestone appeared in the bed of the river. At a place eight or ten miles lower, the same rock abounds over the plains, and in the town is a salt well celebrated from its use in washing cloths of fine colors manufactured there, and to the fixing of which it is essential. I descended the well, and with some difficulty broke off specimens of the rock, which was deep blue slate-like stone, as if the clay were passing into the limestone, and between the thin slabs were layers of salt. The specimens were lost, but I hope to procure others. The salt was in great part composed of muriates of soda and carbonate of soda, but they were not examined. Carbonate of soda effloresces on the surface not far off, and this on being melted with powdered quartz in the manufacture of bangles affords, attached to the glass, a hard solid *pure* white coat of muriate of soda, $\frac{3}{4}$ of an inch thick. Copious springs abound in the blue limestone, and those I saw were sweet, and probably flowed from the neighbouring sandstone. In a cavern in the lime opening above by a great longitudinal fissure, like that of Duncombe park, after a rapid descent of perhaps 30 or 40 yards, I found further progress stopt by a stream of water running over a quartz sand. When the water was low, the natives told me they could go further, but at that time it reached within half a foot of the roof of the contracted extremity. The sand was probably derived from the cap of the adjoining hill. The sides were rough, with stalagnite exceedingly like the *kankar* found in great beds lying on the limestone. It is probable that the stream is not long subterraneous, as numbers of small fish approached the torches. The natives gave them a name, but I regretted I could not catch one for examination. Superstitious stories led me to examine this, and other likely places for organic remains, and I think it probable, such may yet be found. In the sandstone are the celebrated diamond mines of *Banganopilly*. Shafts being sunk through the rock, till they reach the conglomerate containing the numerous species of minerals which experience has shewn to be associated with the gem, this is excavated and sent out of the mine to be broken up in search of the diamond. This conglomerate does not occupy a complete stratum, but generally varies in thickness. The sandstone in many places has been subjected to violent forces injecting, between its layers, a reddish iron-looking sandy rock, which has bent the thin strata above and below out of its place, and at others forced a way through the numerous vertical divisions of the stone, and appears to have flowed in a semifluid state over the surface, and to have carried along with it angular fragments of the rock, which are fixed in it like plums in a cake. In one or two instances, the fragments seemed to have been broken, but not removed from their original situation; the lines of separation being filled with the same matter that flowed out. The end of a neighbouring hill is covered with round stones, several feet in diameter, hard, black, and apparently composed of trap, and called in the language of the country "black balls." The trap rocks are not known to exist within 50 miles. Amongst the "diamond stones," as they are called, there is one of a jet black, and very hard, suggesting that it might be of a carbonaceous nature; and the appearances of the action of fire would favour an hypothesis of the carbon of this mineral being changed by that action into the diamond. This is a mere fancy, but it seems sufficient to direct inquiry. The *Chinúr* mines are in general formed by the destruction, by water, of hills, such as *Banganopilly*. The blue limestone has also experienced violent changes, forcing the strata into vertical and curiously contorted shapes, but in general it is little disturbed. I did not find nor hear of the remains of shells, although I looked anxiously for them; but there were, in many situations, numerous tubular perforations usually full of a *kankar* like matter mixed with iron, and very subject to decay. They were often arranged in rows, and sometimes lost in the stone gradually. If these are justly regarded as peculiar to lacustrine deposits, the absence of shells is singular; but at Ellore, I have seen the trap perforated by similar shaped calcedonies, most properly compared to tobacco-pipe stalks. These rocks abound with curious minerals and phenomena, but these are the principal facts I observed connected with the question of the relations of the sandstone. I met with a blue limestone perforated as above, in the *Guntoor Circar*, running into the white lithographic marble of *Manopilly*, on the *Kistnah*, and probably in some way connected with the diamond deposits of the district. The identity with the Hindústan sandstone appears from the number of variegated marks and of grits in the beds; from its use for architectural purposes, in being horizontally stratified; in the strata being sometimes unconformable;—in its being in the neighbourhood of saline deposits of the same kind, and in both containing diamond mines and various iron ores;—in its passing into quartz rock, and being interstratified with clay slate, though rarely. If there is no misprint, it differs in lying *on* instead of being *covered by* a blue limestone, without fossils: vide Gleanings, vol. iii. p. 213.

P. S. The clay slate is sometimes wanting, and the sandstone then lies on the blue limestone as at *Pushpagarry*, immediately above the *Chinúr* diamond mines; and here there are larger grits than in most other places, and small veins of quartz. Below the mines, the limestone is much contorted and dislocated. The limestone is not one of the diamond stones of the miners, although it abounds with the gem in the beds of Chinúr. Nor is there any trap rock amongst them, although Werner asserts they are found in Orissa at the foot of trap mountains. The subject of the origin of the "*terreins de transport*," in which they are found, is demonstrated by the associated stones in my possession; but it appears very doubtful, whether they are of diluvial origin, as asserted by Buckland, using the word as opposed to alluvial. See *Reliquiæ*, page 220, and *Brongniart's Traité*.

## VI.—*An Experimental Inquiry into the Means employed by the Natives of Bengal for making Ice.* *By* T. A. Wise, *Esq. M. D.*

(Read 3rd October, 1832.)

A large quantity of ice is used during the cold season in Bengal, for purposes of luxury, which is supplied by natives at a comparatively cheap rate, from their employing a process by which they can make a large supply at a moderate expence. As very imperfect accounts have hitherto been given of the means they employ, and as most erroneous opinions are generally received regarding the causes by which the required degree of cold is produced, I hope a short account of the principal ice-manufactory in Bengal will not be considered unworthy the notice of the Society.

A particular field in the neighbourhood of the town of Hooghly has been many years in requisition as the place for making ice, and is said by the natives to be the only one in this part of the country in which it can be produced in any considerable quantity: this seems the more reasonable, as the trials to make ice at Serampore, Calcutta, &c. may be considered to have failed when the quantity is compared with that obtained at Hooghly. This peculiarity may be owing to the elevation, exposure, and distance of the latter from the sea. The soil of the field in which the ice is made is a black loam upon a substratum of sand; it is more elevated than the surrounding country, is liable to partial inundations in heavy rains, and is skirted on the south, east, and north by trees, and on the western and northern directions has an open plain for some extent.

The manufacturing commences towards the end of November, and generally continues until some time in February. These periods vary in different years, owing to such circumstances as the quantity of water upon the ground at the close of the rains, the early or late cold season, its length, &c.

The best months for making ice are the latter part of December and the whole of January; and during November and February, there are generally only a few nights in which ice is made in any quantity.

The natives commence their preparations for making ice by marking out a rectangular piece of ground, about 120 feet long, by 20 broad, in an easterly and westerly direction, from which the soil is removed to the depth of two feet. This hollow is smoothed and allowed to remain exposed to the sun for some time to dry, when rice straw in small sheaves is laid in an oblique direction in the excavation, with loose straw upon the top, to the depth of a foot and a half, leaving its surface half a foot under the level of the ground. Numerous beds of this kind are formed, with a narrow path between them, in which large earthen water-jars are sunk into the ground for the purpose of having water near, to fill the shallow unglazed earthen vessels in which it is to be frozen. These dishes are nine inches in diameter at the top, diminishing to $4\frac{3}{10}$ inches at the bottom, $1\frac{3}{10}$ deep, and $\frac{3}{10}$ of an inch in thickness; and are so porous as to become moist throughout when water is put into them.

During the day, the loose straw in the beds above the sheaves is occasionally turned up, so that the whole may be kept dry, and the water-jars between the beds are filled with soft pure water from the neighbouring pools. Towards evening, the shallow earthen dishes are arranged in rows upon the straw, and, by means of small earthen pots tied to the extremities of long rods of bamboo, each is filled about a third with water. The quantity, however, varies according to the ice expected; which is known by the clearness of the sky and steadiness with which the wind blows from the N. N. W. When favourable, about eight ounces of water is put into each dish, and when less is expected, from two to four ounces is the usual quantity; but, in all cases, more water is put into the dishes nearest the western end of the beds, as the sun first falls on that part, and the ice is easier removed from its solution being quicker. There are about 4590 plates in each of the beds lately made, and if we allow five ounces for each dish, which presents a surface of about four inches square, there will be an aggregate of 239 gallons, and a surface of 1530 square feet of water in each bed.

In the cold season, when the temperature of the air at the ice-fields is under 50°*, and there are gentle airs from the northern and western direction, ice forms in the course of the night in each of the shallow dishes. Persons are stationed to observe when a small film appears upon the water in the dishes, when the contents of several are mixed together and thrown over the other dishes. This operation increases the congealing process. A state of calmness has been discovered by the natives to diminish the quantity of ice produced; and this is confirmed by the fact well known in our laboratories, that water may be gradually cooled down many degrees below the freezing point without congealing, provided it be kept perfectly still. When the sky is quite clear, with gentle steady airs from the N. N. W. the freezing commences before or about midnight, and continues to advance until morning, when the thickest ice is formed. I have seen it $\frac{7}{10}$th of an inch in thickness, and in a few very favourable nights, the whole of the water is sometimes frozen;

* Fahrenheit's thermometer is used in the following essay: a minute having been allowed for each experiment.

when it is called by the natives solid ice *(pakka baraf)*; when it commences to congeal between two or three o'clock in the morning, thinner ice is expected, called *paperí*; and when about four or five o'clock in the morning, the thinnest is obtained, called *phúl baraf*. The freezing is frequently retarded in its formation during the night by the wind rising to a breeze about 11 or 12 P. M.,—by clouds, &c. and the ice in consequence does not begin to form until towards morning.

In the most favourable nights, the dishes are generally found encrusted with ice, both on their inner and outer sides, which adheres to the rough surface of the plate with such a degree of firmness as to require it to be partially dissolved before it can be separated from the dish. I have often seen the natives wait until the sun was two hours and a half above the horizon, before they could remove it.

Seven or eight persons, generally women, are allowed for each bed, who with semicircular blunt knives remove the ice and water into earthen vessels placed near them, which are moved along as they proceed in their work. When these vessels are full, they are emptied by men employed for that purpose, into conical-shaped baskets placed upon the jars between the ice-beds which retain the ice, and allow the water to flow into the water-jars. When the baskets are filled, their contents are conveyed to temporary ice pits, which are about six feet deep, by four in diameter, and are lined with mats. The ice is covered with straw, and allowed to remain until evening, when it is again taken out and placed in large pits. These consist of circular holes in dry situations from 10 to 12 feet deep, by 8 or 10 feet in diameter. These pits are well lined with mats, and when nearly filled, some more straw and a shed of the same material is placed over the ice. These non-conductors of caloric are not sufficient to prevent the influence of the neighbouring media, and a slow solution of the ice is the consequence, the water of which is conveyed by a small hole, below the level of the pits, to a well near it, from thence it is occasionally removed.

During the colder months, the ice is conveyed in the evening, in bags of coarse country cloth, to boats in which it is put in bulk, and defended from damp and heat, and is sent to Calcutta during the night, the distance being about 40 miles; but, as the wastage is very considerable at the beginning and towards the end of the season, when it is most required and bears the highest price, it is then conveyed thither in baskets lined with straw and mats, and arrives before sun-rise.

The ice which is not immediately required remains in the pits while the ground is dry, where it slowly dissolves, especially along its sides; but as soon as rain falls in any considerable quantit its high temperature quickly dissolves what remains.

Repeated trials have been made at different times to accomplish the desirable object of keeping the ice during the hot season; but so great is the first expense, and so small a quantity of that produced yields any return, that hitherto every trial has proved unsuccessful, and has entailed a heavy loss on the speculator. For the two last seasons, another attempt has been made to keep ice, but although every precaution was employed to guard against the influence of the surrounding media, so powerful was it found during the last season, when the trial was for the first time properly made, that the experiment proved unfavourable, or only partially succeeded. The ultimate success of the measure must now however depend in a great measure on the encouragement it receives in Calcutta, through which the best hopes may be held out of introducing one of the greatest luxuries in a tropical climate during the hot-season.

When the ice bed is examined after a favourable night, the straw exposed between the plates and their sides is found covered with hoar-frost, and near the water on the inner side small irregular nodules of ice appear.

When the night has been very favourable, so as to freeze a considerable portion of the water, numerous small globules of air, naturally combined with water, are disengaged during the freezing process, and are found swimming upon the surface of the water, while others remain attached to the bottom of the plate.

The separation of air from the water increases as the congelation advances, and retards its progress more and more, as the proportion of ice is greater, until nearly all the water is congealed, when a large globule of air is left at the lower and central part of the ice.

By expelling the air naturally contained in the water, by boiling, an increased quantity of ice is produced, but the expence of doing so is too great to admit of its being generally employed. On an evening in the cold season, I boiled some water for a short time, and found next morning more ice, but apparently as much air as in the neighbouring dishes.

When the wind attains a southerly or easterly direction, no ice is formed, from its not being sufficiently dry, not even, though the temperature of the air be lower than when it is made with the wind from a northern or western point. The most favourable direction of wind for making ice is the N. N. W. diminishing in power as it approaches the north and west: in the latter case, more latitude is allowed than from the N. N. W. to the north. So great is the influence of the direction of the wind on the ice, that when it sometimes changes in the course of a night from the N. N. W. to a less favourable direction, the change not only prevents the formation of more ice, but dissolves what may have been formed. On such occasions a mist is seen hovering over the ice-beds, from the moisture upon them, and the quantity of humidity contained in the wind. A mist in like manner forms over deep tanks during favourable nights for making ice.

Another important circumstance in the production of ice is the degree of wind. When it approaches a breeze, no ice is formed. This is explained by such rapid currents of air indicating a considerable difference of temperature between the situation from whence it passes, thus removing the cold air before any accumulation has taken place in the ice-beds. It is for these reasons that the thickest ice is expected when during the day a breeze has blown from the N. N. W. which thoroughly dries the ground, and towards evening and during the night diminishes to gentle airs, which steadily proceed from the same quarter, so as to allow the full influence of radiation and the impressions from the clear sky.

The ice dishes present a large moist external surface to the dry northerly evening air, which cools the water on them, so that, when at 61°, it will in a few minutes fall to 56°, or even lower. But the moisture which exudes through the dish is quickly frozen, when the evaporation from the external surface no longer continues to produce much effect.

To detect the influence of evaporation in producing ice, one of the dishes was placed in the evening upon a patch of grass, five feet above the level of the ice-beds, so as to be exposed to the full influence of the sky and the cold northerly wind. This was the most favourable situation for promoting evaporation. The night proved a favourable one for the formation of ice, and in the morning the dishes in the beds were covered with it, but the dish upon the elevation had lost weight during the night, and had no ice upon its surface; the water soon after sun-rise was at 46°, on another morning the water stood at 50°. This experiment was varied by placing a brass vessel of the same size and form as the common plates upon a sprinkling of straw on an elevated piece of ground near the ice-beds. In the morning it was found about the same weight, without any ice, although the plates on the beds were covered with thick ice. On the same morning one of the porous earthen vessels similarly situated, and covered on its under side with tinfoil, presented the same result.

As a further proof of the cold not being produced by evaporation, I next carefully weighed a number of the unglazed dishes in the evening and again in the morning, when I found that they had gained considerable weight, which was owing to the absorption of moisture on the surface of the water exceeding the loss by evaporation from the external surface. The quantity of cold water which is sprinkled over the dishes is not sufficiently large to explain the great increase in the weight of the dishes, which I found was about the same when no water had been thrown over the bed. Glazed vessels of different colours were placed amongst the unglazed, which in the morning were found to have thicker ice, and to have gained more weight than the common dishes.

In eight experiments with the common unglazed ice-dishes, the average gain in weight, was 68.5 grains; and of five experiments with smaller black-glazed slightly porous dishes, this average was 110 grains. As the surrounding media must have a great influence on the formation of ice, I noted their different temperatures. The air at the ice-fields was always found warmer in the evening, and much colder in the morning, than at the neighbouring village of Bandel, where the ground is more sheltered by trees, from the direct influence of the sun's rays. The average of a number of experiments in favourable weather for making ice, gives, at Bandel, 70 degrees in the evening, and 56 in the morning; and at the ice-fields 72° in the evening, and 46° in the morning.

The temperature of the different substances in the neighbourhood, or forming part of the ice-beds, was examined a little before sun-set and soon after sun-rise: on a clear evening and favourable morning, they were found to be as follows;—

| | *Morning.* | *Evening.* |
|---|---|---|
| The air 5 feet above the ice-beds, ................ | 42° to 46° | 72° |
| Water in the large jars between the ice-beds,...... | 44 to 60 | 68 |
| Water in a deep tank in ice-fields,................ | 57 | 77 |
| Ground in the neighbourhood, immediately under the surface,.............................. | 54 | 57 |
| Straw in the ice-beds, 3 or 4 inches under the surface, | 42 to 46 | 48 |
| Ditto, of a thatched hut in the ice-fields, obliquely exposed to the sky,......................... | 44 | 61 |

The temperature that generally prevails on nights fitted for the manufacture may be learned from the following table, for which I am chiefly indebted to Mr. Herklots, Fiscal of Chinsurah.

*Abstract of a Table of* 11 *years' Observations on the Temperature of the Air at Chinsurah between the dawn of day and sun-rise, during the season of Ice manufacture, by Mr. Herklots, Fiscal of Chinsurah. The thermometer at the Ice-fields generally stood* 6 *or* 7 *degrees lower; but this is not shewn, except in the last year from Dr. Wise's Observations.*

| Mean temperature of the air at Chinsurah. | | 1831-32. Chinsurah. | 1831-32. Ice-fields. | 1831-32. Quantity. | 1831-32. Wind. | | 1831-32. Chinsurah. | 1831-32. Ice-fields. | 1831-32. Quantity. | 1831-32. Wind. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ° | ° | | | | ° | ° | | |
| 1819-20. Dec. ...... 54.6 | Nov. 6 to 20, | 59.0 | | | | | | | | |
| Jan. ........ 49.9 | December 8, | 56.0 | .. | *a* | NE. | January 26, | 52 | .. | *a* | SW. |
| Feb. ..... 55.0 | 9 to 23, | 56.7 | .. | .. | NW. | 27, | 52 | 45 | *a* | SW. |
| 1820-21. Dec ....... 52.5 | January 3, | 51. | 29 | *b* | NNW. | 28, | 54 | 49 | .. | W. |
| Jan. ........ 51.4 | 4, | 49. | 44 | *a* | NW. | 29, | 56 | 47 | .. | SW. |
| To Feb. 7. .... 53.1 | 5, | ? | 45 | *b* | NW. | 30, | 60 | 59 | .. | SW. |
| 1822-23. Nov.25 to 29, 57.0 | 6, | 48.8 | 45 | *b* | NW. | 31, | 56 | 46 | .. | SW. |
| Dec. ...... 55.4 | 7, | 49. | 46 | *a* | NW. | February 1, | 54 | 44 | *a* | W. |
| Jan. 1 to 21, 55.0 | 8, | 52. | 46 | *a* | W. | 2, | 53 | 44 | *a* | NW. |
| 1824-25. Dec. 7 to 28, 54.6 | 9, | 53. | 50 | .. | NNW. | 3, | 52 | 43 | *a* | NW. |
| Jan. 2 to 19, 54.0 | 11, | 58. | 55 | *a* | SW. | 4, | 52 | 43 | *a* | NW. |
| 1825-26. Dec.16 to 28, 54.2 | 12, | 58. | 50 | .. | NNW. | 7, | 57 | 52 | .. | N. |
| Jan. ........ 53,0 | 13, | 56. | 54 | .. | NW. | 18, | 60 | | .. | SE. |
| Feb. 1 to 10, 55.0 | 14, | 53. | 47 | *a* | NNW. | 20, | 58 | | | |
| 1826-27. Dec. ...... 54.5 | 15, | 52. | 46 | *b* | NNW. | 28, | 60 | | | |
| Jan. ....... 52.3 | 16, | 49. | 44 | *c* | NW. | 29, | 56 | | | |
| 1827-28. Dec. ...... 55.4 | 17, | 48. | 42 | *c* | NW. | | | | | |
| Jan. ........ 52.2 | 18, | 47. | 41 | *c* | NW. | March 1, | 56 | | | |
| Feb. 1 to 19, 55.0 | 19, | 49. | 45 | *b* | NW. | 3, | 56 | | | |
| 1828-29. Dec.18 to 31, 56.1 | 20, | 48. | .. | *b* | NW. | 9, | 59 | | | |
| Jan. ........ 54.4 | 21, | 50. | 31 | *b* | NW. | 11, | 56 | | | |
| Feb. 1 to 17, 54.8 | 22, | 48. | 45 | *a* | NW. | 12, | 58 | | | |
| 1829-30. Dec. 5 to 31, 54.8 | 23, | 52. | 47 | *b* | NW. | 14, | 56 | | | |
| Jan. ........ 52.5 | 24, | 50. | 48 | *a* | NW. | 15, | 60 | | | |
| Feb. no ice. | 25, | 51. | | *a* | SW. | | | | | |
| 1830-31. Jan. 1, ..... 30.0 | | | | | | | | | | |
| 2 to 30, .... 53.2 | | | | | | | | | | |
| Feb. ...... 55.2 | | | | | | | | | | |
| Mar. to 6th,. 54.4 | | | | | | | | | | |

| | |
|---|---|
| Number of days on which ice was formed in small quantity (*a*), ................................ | 17 |
| Ditto ditto of an average amount, (*b*), .............. | 7 |
| Ditto ditto very abundantly, (*c*), .................. | 3 |
| Total Ice-days in 1831-32. . | 27 |

*Note.* In lieu of the more copious table given by Dr. Wise, we have condensed his own and Mr. Herklot's Observations into one table, which in fact shews all that bears upon the question of Ice-making, namely, the general temperature under which it can be formed, and the prevailing wind.—Ed.

The result of the observations of last season, as shewn in the above table, proves that it is not by the temperature alone we are to judge of the number of nights in which ice is produced, for, owing to the frequent and heavy falls of rain and the number of cloudy days last season, there were very few nights in which ice was formed, although the temperature was for an unusual number of mornings at the degree required for producing it. The average number of nights in one season in which ice forms is from 25 to 30; of these there are about 18 favourable, in which the air is cold, the thermometer at Bandel under 54°, or, at the ice-fields, 48°. The very cold nights are from six to eight in one season, or in which the thermometer is below 48° at Bandel, or in the ice-fields, 42°. The careful record of last season shews there were 27 nights on which ice was formed, of which only three nights were very favourable, seven favourable, and 17 less so.

As the influence of straw in producing the necessary degree of cold must be considerable, the following experiments were tried. One of the common unglazed dishes was placed at the bottom of one of the ice-beds, with a very small quantity of straw between it and the earth, and another dish of the same kind was placed in the same way without any straw under it. Next morning I found ice had formed upon the water in the dish which was put upon the straw in the ordinary way, but there was none on the dish which had been placed without, nor on another at the bottom of the ice-beds; the water in the dish upon the sprinkling of straw being at 50°, and the other upon the earth at 52°. Soon after sun-rise on the same morning, the water in an ice plate, put upon the walk between the ice beds, stood at 46°, and in the large water jar between the beds at 60.5°.

As a further proof of the influence of straw in producing the degree of cold necessary for forming ice, a register thermometer was placed upon the straw with its bulb exposed to the sky near the side of one of the beds, after several of the plates had been removed, when it was found to indicate as follows:—

| Date. | Time. | | Temperature. | | Covered with hoar-frost. | Minimum. | Maximum. | Straw between the plates. | Temperature of the air 4 feet above the beds. | | Difference between the air at the surface of the straw & 4 feet above it. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Morning. | Evening. | Morning. | Evening. | | | | | Mor. | Evg. | Mor. | Evg. |
| 1832. | | | ° | ° | | ° | ° | ° | ° | ° | ° | ° |
| Jan. 20. | 7 A. M. | .. | 28 | .. | covered | 26 | .. | .. | 47 | 65 | 21 | .. |
| 22. | 7 A. M. | 5 P. M. | 47 | 70 | . | .. | 121 | 42.5 | 48 | 61 | .. | 60 |
| 23. | 7 A. M. | .. | 34 | .. | covered | 29.5 | 114 | 34 | 47 | .. | 17.5 | .. |
| 24. | .. | 5½ P. M. | .. | 59 | .. | .. | 114 | .. | 48 | .. | .. | .. |
| 25. | .. | .. | .. | .. | covered | 29 | 124 | .. | .. | .. | .. | .. |

This table presents a high maximum and very low minimum temperature, which is to be explained by the non-conducting and powerful radiating property of the straw, &c. and, in the morning, in part to the production of hoar-frost.

As the kind of dishes employed must have a considerable influence on the temperature of the water they contain, I employed the following means to detect the influence of the material of which the dishes were formed. A morning was selected when the wind had suddenly changed towards daybreak to the S. W. direction, when the air was mild and moist, and ice had formed on very few of the dishes placed upon the straw. Soon after sun-rise a mist appeared over the ice-beds. The air was at 53.5°, and the temperature of the straw 42°. The temperature of the water, which in one of the common unglazed dishes in the evening was 56°; in a black glazed one was 58°; in a white glazed one, 59°; in the morning the temperature of the water in one of the common unglazed dishes, with a film of ice on its surface, was at 34°, in the dish next it without ice 35°. The water in a white saucer had a thin sheet of ice upon its surface and was 35°, and in a deep white cup, without ice 39.5°, in a black glazed cup 36°, in a deep one of the same material 38°, and in a flat glazed plate 36°. On another morning of the same kind, a black coloured copper vessel had no ice, while a white painted brass vessel was covered with it.

The influence of brass dishes in conveying away the heat was made evident by the ice being thicker than on the other dishes, and extending from the under edge of the plate of ice upon the surface of the water for some distance along the inner surface of the brass dish. (February 2.) The ice was thick, and numerous small triangles were found a little to one side of its centre, which were not completely closed at their apices, and around this central point the ice was bulged out and thin, and, on examining its under surface, numerous crystals were found to have formed at the raised part where the ice was thinner; from whence they shot obliquely towards the centre of the water, underneath the upper plate of ice, where a small aperture was situated.

On the 2nd and 3rd of January, (1832,) there was only a thin film of slightly irregular ice on the surface of the brass dishes without any appearance of ice upon the water, in most of the plates, which with the exposed portions of straw, grass, &c. were moist. The water in the dishes which had not frozen near the sides of the beds, stood at from 32° to 33°. In a dish put upon another with water in it the upper stood at 32°, and the under at 33°. From these experiments the water appears to be influenced by its depth, exposure, and the materials and colour of the dishes employed for making ice.

In Bengal the day is always hot, and the tendency of caloric to arrive at a state of equilibrium would soon render bodies on the surface of the earth of the same temperature, were it not that each has an aptitude to receive and a power to discharge caloric, which is influenced principally by the nature of the surface of the body and its temperature. The degree of heat will vary with the power of the body, which may, however, be influenced by the evaporation from it by winds and air heated by contact with the earth becoming specifically lighter and rising on the atmosphere. By the continual operation of these causes an accumulation of caloric in the earth is prevented during the day, and as soon as the sun sets, the increase of heat is checked and the night is generally cool under a clear and sparkling firmament even during the hottest season. This is in consequence of the generality of bodies on the face of the earth radiating caloric in large quantities, especially when exposed to the clear sky, as they receive few rays from the neighbouring bodies in return for what they radiate into space. So powerful are these causes in producing a great degree of cold, that in very favourable mornings drops of dew may sometimes be found congealed in Bengal upon thatched roofs, and upon the leaves of some plants during the cold weather. The cooling process advances more rapidly than could be supposed by one who has not experienced it himself, and proved the justness of his feelings by the aid of the thermometer. In the open plain in which the ice is made, I have seen the temperature of the air four feet above the ground fall in the time the sun took to descend the two last degrees before its setting from 70. 5° to 57°.

Pieces of glass and tin were placed under the common dishes in the ice-beds: in the morning they were carefully examined, and their under surfaces were covered with large drops of moisture. A piece of glass eight inches long and seven broad was placed on the evening of the 24th January, 1832, under an ice plate among the other dishes upon the straw in the beds, after it had been weighed; next morning, the dish was found to have gained 120 grains in weight, and, as there was no ice, the water was found to stand at 34°. A dish placed upon a plate of tin similarly situated with the last, gained 60 grains, and the water stood at 38°. On the 26th January, there was very little ice upon the plates, and a piece of glass and another of tin of the same size as the last were placed under two dishes which had been accurately weighed. In the morning the dish upon the tin had very little ice upon its surface, and had gained 70 grains; the dish upon the glass had no ice and had gained 160 grains.

(17th January, 1832.) This evening the following varieties of dishes were placed among the common dishes. A brass dish of the same shape and size as the common unglazed dishes weighed the same evening and morning. On another morning the experiment was repeated with the same result. The ice however was thicker and more equal throughout on the brass dishes than on any of the others; as water boils more readily in metal, so it freezes more readily—hence little appearance of crystallization was observed, and near the centre of one of the plates of ice a small triangular opening was left. The ice was sooner detached from the dish by the heat of the sun, and a thin rim of ice several lines in breadth was found descending along the metal beyond the under surface of the ice.

One of the common dishes, lined with a coating of gum-lac on the inside, weighed the same evening and morning:—another coated on the outside had less ice, and more crystals, and lost a quarter of an ounce by weight; and one lined with tinfoil on the inside was of the same weight evening and morning.

The ice on these dishes was thicker, presented fewer crystals, and had less air in the interior; more especially on the one lined with lac on its inside. The brass vessels had less bubbles than the common dishes, probably from the air flying off as it was detached from the water, as it had less hold on the smooth surface; and on the two lined on the inside the ice was easily detached from the plates.

The application of these results to the explanation of the manner in which ice is formed in Bengal becomes sufficiently evident. The influence of the soil and the elevation of the dry ground, its inland situation and free exposure to the sky, and the quantity of dry straw presenting a large mass of a bad conductor of heat, which penetrates but a short way into it during the day*;—and as soon as the sun descends below the horizon this large and powerfully radiating surface is brought into action upon the thin porous vessels,—themselves powerful radiators.

The night air descends to the earth's surface by the removal of the heating cause, and deposits a portion of its moisture upon the powerfully radiating and therefore cold surface of the straw and the large moist surface of the dishes. The cold dry north-west breeze of the day dries the ground, and declines towards the night into moderate airs, which pass slowly over the dishes and prevent the accumulation of caloric on their surface from the deposition of moisture.

The combined influence of the above agents seem sufficiently powerful to account for the degree of cold required for forming ice, as the above experiments appear to me to prove.

* I have strong reasons for believing that electricity has a considerable influence on the formation of ice, but I have not had sufficient opportunities of investigating this important point, which I must leave to form the subject of another communication.

## VII.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 20th February,* 1833.

George Swinton, Esq. in the Chair.

After the Minutes of the last meeting had been read, the Society proceeded to ballot for Colonel John Briggs, Dr. J. N. Casanova, and Rev. John Macqueen proposed on that occasion, who were unanimously elected Members.

Sir Benjamin Malkin, Recorder of Penang, proposed by Sir E. Ryan, seconded by Mr. J. Prinsep, was upon the favorable report of the Committee of Papers, elected an Honorary Member.

The Secretary announced, that the Committee of Papers had, upon the authority of the resolution at the last meeting, disposed of two notes, value Rupees 5,500, for the liquidation of the debts standing against the Society.

The Secretary also reported, that in consequence of new arrangements made by him as Editor of the Journal of the Asiatic Society, he trusted that he should in future be able to supply that work gratis to the members of the Society. Mr. W. H. Macnaghten remarked that no notification had been circulated to the members acquainting them with the resolution of the 7th March, and giving them the opportunity of possessing the Journal then allowed to be published under its auspices; he thought that such notice should be issued both with reference to the former volume, and to the future numbers; and it was ordered accordingly.

The Secretary explained to the meeting, that Mr. Wilson, previous to his departure, had reported to Government the completion of Mr. Csoma de Körös' Tibetan Grammar and Dictionary, and had offered to take the manuscripts to England for publication; but that the Honorable the Vice-President in Council, being of opinion that the works might more appropriately be published in this country, under Mr. Csoma's own eye, Mr. Wilson had made them over to the Society. He had therefore followed up the subject by a second application to Government on the 30th January, to which the following reply had just been received:

To James Prinsep, Esq. *Secretary to the Asiatic Society.*

Sir,

I am directed to acknowledge the receipt of your letter, dated the 30th ultimo, reporting the inability of the Society to defray any part of the expense which will attend the publication of Mr. Csoma de Körös' works.

2nd. In reply, I am directed to acquaint you, with reference to the concluding paragraph of your letter, that it was intended by Mr. Swinton's letter to Mr. Wilson under date the 27th ultimo, to intimate that Government would take upon itself the expense of the publication of Mr. Csoma de Körös' works, and I am now directed to acquaint you, that the Right Honorable the Governor General in Council will be happy to sanction the estimate furnished in your letter.

3rd. It is obviously desirable that the work should have the benefit of the learned author's superintendence during its progress through the press, and His Lordship in Council trusts, that it may be entered upon immediately. I am further directed to tender to yourself the acknowledgments of Government for the valuable assistance you have offered on your own part.

I have, &c. &c.

(Signed) W. H. MACNAGHTEN,

*Offg. Chief Secy. to Government.*

*Council Chamber, 12th February,* 1833.

The Secretary stated that arrangements had accordingly been made with the Baptist Mission Press, to commence upon the Tibetan Grammar and Dictionary immediately.

Read, a letter from Mr. W. Twining, Secretary to the Medical Society, acknowledging the receipt of the 1st volume of the Journal of the Asiatic Society, and vol. xvii. of the Researches.

*Library.*

The following books were presented:

3rd vol. of *Flora Indica,* or Description of Indian Plants, by the late Wm. Roxburgh, M. D. F. R. S. &c. &c.—*by Capt. James Roxburgh, on the part of himself and brother, Editors of the work.*

Proceedings of the Zoological Society for 1830, 31, and 32—*by the Society.*

The following works,—*by their author Sir J. F. W. Herschel.*

On the Separation of Iron from other Metals.

On a New Method of Computing Occultations of the Fixed Stars.

An account of Observations made with a twenty-feet Reflecting Telescope in the years 1826-27-28-30, on the Parallax of the Fixed Stars.

An account of Determining the Difference of Meridians.

Herschel's Micrometrical Measures.

Ditto's Account of the Repetition of M. Arago's Experiments.

Humboldt's Fragmens de Geologie.—*By the author.*

Vaillant's Numismata Imperatorum Romanorum, 3 vols. and

Agostini on Medals, 1 vol.—*by C. R. Prinsep, Esq.*

Nos. 54, 55, 56 of the Jour. of the Asiatic Society of Paris.—*By the Society.*

Meninski, Thesaurus Linguarum Orientalium, 3 vols. and

Federici Borromæi Thesaurus, 1632, vols. 4.—*by Baboo Ramcomal Sen.*

A complete copy of the Calcutta Journal, bound in quarto,—*by the Secretary.*

Essai sur le Madar (Calotropus Madarii),—*by J. N. Casanova, Esq.*

A copy of "Vidvunmoda Tarunginee," *by Maha Raja Kalikissen Bahadur.*

A copy of the New Testament and the Psalms of David, translated into the Malagasy language, at the Missionary establishment of Tananarivo,—*by C. Telfair, Esq. President of the Nat. Hist. Soc. Mauritius.*

Meteorological Registers for December, 1832, and January, 1833.—*by the urveyor General.*

Lardner's Cabinet Cyclopedia—Chemistry 1 vol.—*received from the Booksellers.*

*Physical.*

Read a letter from Mr. G. Swinton, communicating correspondence between Mr. Robison, Sec. Ed. Roy. Society, and several paper manufacturers, on the subject of the Nipal Paper Stuff.

The experiments tried by the paper manufacturers at home upon the dried pulp of the Nipal paper stuff made up into bricks (as described in the Journal, 1st vol. page 10,) and sent home by Mr. G. Swinton in 1831, do not seem to have been at all successful. The specimens furnished by Mr. C. Cowan to Mr. Robison possess neither the softness nor toughness of the paper manufactured in the valley itself, according to the methods detailed by Mr. Hodgson. They are brittle and stiff; transparent, as if impregnated with varnish, and full of gritty brown spots. The colour of the specimen marked "strongly bleached" is still far from being of a good white. It took about 10 lbs. of strong dry chloride of lime, and two lbs. of sulphuric acid, to bleach 90 lbs. of the material, being four or five times as much as is necessary with ordinary stuff, and the texture was doubtless injured thereby. It retained the water very obstinately on the sieve, and shrank remarkably on drying. The thin sheets made in Nipal and sent home in 1829, by Mr. Swinton, were on the contrary exceedingly tough, flexible, though not quite white; they more resembled what is called "India paper," and took the minute impression of a bank note plate with perfect fidelity.

Mr. Charles Cowan mentions in his notes on working-up the stuff, that it was found to be as tough as any material with which he was acquainted, which proves that it must have deteriorated since. The value of the cakes was estimated by this manufacturer at £6 to 8 per ton, or if fit for cartridge paper, at nearly double. No hopes were entertained of turning it to any more refined purpose.

Read a letter from the same Member on the subject of the *Garjan* or wood-oil procured in the forests of the Tenasserim provinces, a large quantity of which he had also transmitted to the Sec. of the Ed. Roy. Society, to ascertain its value in the English market.

This oil is in general use among the natives here for mixing with colors, and is chiefly imported from Chittagong, but it would appear on Major Burney's authority to be still more abundantly produced in the Tavoy district, and at much less cost; the bazar price in Calcutta averaging about 9 or 10 rupees per maund, whereas at Tavoy it may be procured at about one-fourth that price. Both in India and in England it has been found to be a good substitute for linseed oil, for outside work, especially in light colors, being worth for this purpose about £12 to 15 per ton.

Mr. Dowie, a currier of Edinburgh, read a paper before the Ed. Society of Arts, on the mode of applying this vegetable oil alone or mixed with tallow to the preparation of leather for shoes, and he considers it as far preferable to fish oil: this application is quite new, and at Mr. Swinton's suggestions some similar trials have since been made in Calcutta, by Mackenzie and Macfarlan, with success. The leather absorbs a great deal of the oil, and the specimens presented to the Society appear to be very soft and tough.

Major Burney describes the tree whence the *Garjan* oil is extracted, as forming large forests in Tavoy, growing to a great height and size; its native name is *Ka-*

*niyen;* the flag-staff at Moulmein, 92 feet high, is formed of a single *Kaniyen* tree. Mr. Maingy says, that the oil is much improved by boiling, which gives it drying properties; he has often used it for boats, and has found it excellent in preparing tarpauling. The inhabitants of Tavoy and Mergui do not burn earth-oil like other Burmese, but torches made of this wood-oil and touch wood. The imports into Calcutta for the last three years were as follows:

| | | | | | | |
|---|---|---|---|---|---|---|
| In | 1829-30, | Bazar maunds | 759, | Average price | 7 | 8 |
| | 1830-31, | | 914, | | 6 | 4 |
| | 1831-32, | | 1708, | | 7 | 2 |

Read a letter from Dr. F. W. Malcolmson, Mad. Euro. Reg. Hyderabad, announcing that he had fallen in with a box of Dr. Voysey's Geological specimens, which he should forward to Calcutta by the first opportunity.

" Among them are two fossil bones (of which he sends drawings)—descriptions and localities may be found in Dr. V.'s. papers. Fig. 1 is part of one of the long bones of a mammiferous animal (probably a goat or deer); its fibrous structure is very distinct, and presents fine yellow veins when cut and polished: internally the remains of the ridges to which the concellated structure was attached are visible. Fig. 2 is one end view of the same filled with a reddish earth, common near some of the granite rocks in the neighbourhood, and it is filled with small pieces of felspar. It is mineralized with the carbonate and a little phosphate of lime. All the other stones appear to have been collected in this district, and there can be no doubt of the locality from which this was obtained."

Dr. Malcolmson also sends the drawing of a chambered univalve fossil shell, in a white limestone, found among Dr. Voysey's collections.

Read a letter from William Onslow, Esq. C. S. dated Futtehpoor, 6th December, begging the Society's acceptance of some old Roman coins dug up upon his father's estate in England.

The sixty-one coins transmitted consist chiefly of the *small brass* of Constantine, among which are some of URBS ROMA and URBS CONSTANTINOPOLIS: also two of the Antonines, two of Domitian, one of Tetricus; the rest are in so decayed a state as not to be decypherable.

Read a letter from Lieut. A. Burnes, dated Bombay 26th Jan. announcing that he had dispatched for the Society some Bactrian coins, collected in his recent journey to the Oxus: also some belemnites and other fossil shells from the deserts.

Specimens of copper ore from Nellore were presented on the part of Mr. Kerr.

The mines appear to lie to the northward of the Pennar river, 36° N. N. W. of Nellore and 37° W. from the sea, near a village called *Ganypenta* in Arrowsmith's Map.

The copper ore prevails over a considerable tract of country—it consists of malachite, and of black anhydrous oxide of copper with red and yellow ochre imbedded in micaceous schist. Mr. Kerr points out that the ore differs from the English coppers essentially, in being free from iron pyrites and other deteriorating ingredients, as lead, antimony, sulphur, &c. which make that ore difficult to purify, whereas the Nellore ore becomes quite pure by simple smelting. The specimen of reduced metal sent with the ores is of a very fine color and highly malleable. Doctor Thompson, 20 years ago, analyzed the ore and found it to contain,

| | |
|---|---|
| carbonic acid,.............................. | 16.7 |
| black oxide copper, ......................... | 60.75 |
| red oxide iron, .............................. | 19.5 |
| silica and loss, ............................. | 3.05 |
| | 100 |

Four different varieties examined by the Secretary contained from 13 to 47 per cent. of red oxide of iron and silex. The appearance of the ore seems to promise ample success to those who have engaged in the working of these mines.

Specimens of the copper ore of Nipal were presented by the Resident Mr. B. H. Hodgson.

This ore is a sulphuret of copper, mixed with a large proportion of ferruginous sulphuret.

A stuffed albatross, presented by Mr. J. Kyd on the part of Captain Henry Hutchinson of the Ship Lord Wm. Bentinck.

Some fossil bones supposed to belong to the Drenti or the Dodo, from the Isle of France, presented by C. Telfair, Esq.

Also a specimen of the silk produced from the Madagascar worm, by the same gentleman.

This silk is reported by competent judges in Calcutta to be "well reeled in the Italian method—the thread is harsh, uneven, and gouty, of 14 or 16 cocoons. The specimen appears old and damaged."

Specimens of the *Scincus Bojerii* and the *S. Boutonii* (J. Desj.), and the *squille* de l'I. Maurice, preserved in spirits; also some fossil bones of the turtle discovered in an estate at Flacq, in the Mauritius. *By* Mons. J. Desjardins.

A letter was read from Monsieur Desjardins, Secretary to the Mauritius Society, presenting to the Asiatic Society, manuscript copies of 24 notes, memoirs, descriptions, &c. composed by himself, on various subjects of natural history. Several of them have been published in the scientific journals of Europe.

The first two papers relate to the organization of the Society for the study of natural history in the island, to which allusion was made in the JOURNAL, vol. i. 157. There are also the rules and the report of the third anniversary meeting, (we have already received the two former reports.) Of Monsieur Desjardins' contributions to natural history, the following list will give the most flattering proof.

Sur une couleuvre prise vivante a l'Ile Maurice, 1829.
Description physique de l'Ile d'Ambre, 1829.
Ditto de la Becasse de Maurice.
Ditto d'une caverne située à la riviere du rempart, 1829.
Ditto des mammiféres de l'Ile Maurice.
Ditto des 20 oiseaux de Madagascar.
Sur une annelide du genre Erpobdelle, *(Lam.)*

Sur trois espèces de lêzard du genre scinque.

Sur un tandree de Madagascar.

Sur trois espèces d'echassiers *(grallæ)* de do.

Sur une coucou pris à l'Ile de France.

Sur quelques poissons de la cote N. O. de Sumatra 1831.

Description d'un oiseau *(scolopax totanus glottis)*, 1829, &c. &c.

*Literary.*

Mr. Telfair also transmitted by the same opportunity a variety of manuscript essays by Mr. Baker and others, connected with the literature of Madagascar, besides the Missionary publications already noticed.

1. Translation of the fable of the alligator and hedge-hog.
2. Ditto of a song concerning the dead.
3. On the ordeal of the Tangéna.
4. Sur les maladies epidemiques de Madagascar.

Portions of some of these papers were read.

*Resolved*, that the last paper be made over to the Medical Society, and that the best thanks of the Society be given to the President and Secretary of the Mauritius Natural History Society.

Thanks were also voted for the other contributions of the evening.

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After the business of the evening was concluded, Mr. W. Macnaghten begged to remind the meeting that this might be the last occasion in which they would enjoy the society of the gentleman who now occupied the chair, in this country—nay perhaps for ever! He had seen his friend in the morning overwhelmed with the fatigues of preparation for embarkation on the morrow, and little thought it possible for him to attend to other engagements; but his ardent zeal for the cause of literature and science had urged him to devote the very last moment of his residence in this land to the Institution with which he had been connected so long. For the affection and interest thus manifested to the last, the gratitude of himself and of his brother members was most due,—and for the modesty which had marked his services to the Society, and which alone had prevented his rising long since to the highest dignity it could bestow. From the time of his quitting college, Mr. Swinton had been distinguished as an Orientalist, and his unimpeachable conduct had marked him as one of the brightest ornaments of the Civil Service. Mr. Swinton, he knew, would wish him to spare such eulogium in his presence, but it would be unjust in him and in the Society to allow their associate to quit them without testifying their anxious solicitude for his safe and happy return to his native land.

Mr. Swinton returned thanks for this expression of feeling on the part of his associates, which he attributed rather to their partiality than to his merits. He had always felt the warmest interest in the Society, and had endeavoured to contribute to its success, whenever an opportunity occurred. He could but now for the last time tender his sincerest wish for its lasting fame and prosperity, and once more returning his best thanks, he bade them farewell.

## VIII.—*Systematically arranged Catalogue of the Mammalia and Birds belonging to the Museum of the Asiatic Society, Calcutta. By Dr.* W. Warlow.

### MAMMALIA.

*Ord.* CARNASSIERS.

*Fam.* Cheiroptera. *Gen.* Galeopithecus.

*Galeopithecus vulgaris.* The Colugo.

*Fam.* Insectivora. *Gen.* Sorex.

*Sorex giganteus*, Geoff. Indian Shrew.

*Fam.* Carnivora. Tribe Plantigrada. *Gen.* Ictides.

*Ictides ater.* This specimen was presented to the Society by Col. Farquhar under the title of long-tailed Bear of Malacca, and has been described by Sir S. Raffles as the "Benturong" in the 13th vol. of the Transactions of the Linnæan Society. Sir Stamford is incorrect in his enumeration of the molar teeth, which are not six on each side in both jaws; there being six in the upper and only five in the lower. In every other particular his description corresponds. The exact number of teeth in *Ictides* I am unacquainted with. Baron Cuvier's account would lead me to the supposition that there are six in each jaw, as in Procyon, whilst I find in the Bulletin Universel, that the teeth are 18 in number in each jaw, namely six incisors, two canines, and 10 molars. There can be no doubt of the identity of the specimen with the Ictides ater of Frederick Cuvier, though it may be necessary to separate the latter from the species with which it has been generically connected.

*Tribe* Digitigrada. *Gen.* Lutra.

*Lutra nair*, F. Cuvier, Indian Otter.

*Gen.* Viverra.

*Viverra Bengalensis*, Hardw.

*Gen.* Felis.

*Felis kutas*, Pearson.
*Felis catus*, a variety of the common cat?

*Ord.* MARSUPIALIA.

*Fam.* Dasyuridæ. *Gen.* Thylacinus.

*Thylacinus striatus.* Zebra Thylacine. Didelphis cynocephalus, Harris.

*Ord.* RODENTIA.

*Gen.* Rhizomys, Gray.

*Rhizomys Sumatrensis.* Bambu Rat, Raffles. This specimen has also been described by Sir S. Raffles, and from his description, Mr. Gray has referred it to his new genus Khizomys, adding however a note of interrogation as to the correctness of the location. It certainly does belong to the genus, but it would be very desirable that a specimen should be sent to Mr. Gray, especially as it is by no means clear that it may not be identical with his *R. Chinensis.*

*Gen.* Hystrix, *Subg.* Atherina.

*Atherina fasciculata.* Brush-tailed Porcupine.

*Ord.* EDENTATA.

*Gen.* Manis.

*Manis pentadactyla.* The short-tailed Pangolin.

*Ord.* MONOTREMA.

*Gen.* Echidna.

*Echidna Hystrix.* Porcupine Echidna.

*Ord.* RUMINANTIA.

*Gen.* Moschus.

*Moschus Javanicus.* The Kautchil.

*Gen.* Bos.

*Bos Bufalus.* }
*—— Taurus.* } Monstrous specimens of the Ox and Buffalo.

*Ord.* CETACEA.

*Gen.* Delphinorhychus.

*Delphinorhychus Gangeticus.* Indian Dolphin.

BIRDS.

*Ord.* II. INSESSORES.

*Tribus* 1. Fissirostres.

I. *Fam.* Meropidæ. *Gen.* Merops.

*Merops viridis.* Indian Bee-Eater.

*Gen.* Alcedo.

*Alcedo Bengalensis.* Indian Kingfisher.

*Gen.* Halcyon.

*Halcyon Smyrnensis.* Smyrna Kingfisher.

*Gen.* Dacelo.

*Dacelo gigantea.* Great Brown Kingfisher.

*Tribus* 2. Dentirostres.

I. *Fam.* Muscicapidæ. *Gen.* Muscipeta.

*Muscipeta cœrulea.* Azure Fly-catcher.

II. *Fam.* Laniadæ *Subf.* Dicrurina. *Gen.* Dicrurus.

*Dicrurus macrocercus.*

III. *Fam.* Merulidæ *Subf.* Oriolina. *Gen.* Oriolus.

*Oriolus Melanocephalus.*

IV. *Fam.* Sylviadæ. *Gen.* Jora.

*Jora Scapularis.*

*Gen.* Accentor.

*Accentor modularis?*

V. *Fam.* Pipridæ. *Gen.* Parus.

*Parus cristatus.* Crested Titmouse.

*Tribus* 3. *Subf.* Alaudina. *Gen.* Alauda.

*Alauda cristata.* Crested Lark.

*Gen.* Emberiza.

*Emberiza Bengalensis.*

III. *Fam.* Covidæ. *Subf.* *Gen.* Barita.

*Barita Destructor.*

*——— Tibicen.*

*Subf.* Corvina. *Gen.* Pica.

*Pica vagabunda.* The Rufous Crow.

*Subf.* Coraciana. *Gen.* Coracias.

*Coracias Bengalensis.* Bengal Roller.

V. *Fam.* Loxiadæ. *Gen.* Cocothraustes.

*Cocothraustes vulgaris.* Common Grosbeak.

*Tribus* 5. Scansores.

II. *Fam.* Psittacidæ *Subf.* Psittacina. *Gen.* Psittacus.

***Psittacus erythrocephalus.*** The grey Parrot or Jaco.

*Subf.* Palæornina. *Gen.* Nanodes.

*Nanodes pulchellus.* The Turcosine Parrakeet.

*Gen.* Platycercus.

*Platycercus eximius.* Nonpareil Parrakeet.

*Gen.* Palæornis.

*Palæornis flavirostris.* Yellow-colored Parrakeet.

—— *erythrocephalus.* Blossom-headed Parrakeet.

III. *Fam.* Picadæ. *Gen.* Bucco.

*Bucco Philippensis.* Yellow-throated Barbet.

—— *Gyanops,* Cuv.

*Gen.* Picus.

*Picus viridis.* Green Woodpecker.

—— *tiga.* Horsfield.

IV. *Fam.* Certhiadæ. *Gen.* Upupa.

*Upupa Epops.* The Hoopoe.

V. *Fam.* Cuculidæ. *Gen.* Cuculus.

*Cuculus Orientalis.*

*Coromandus.* Colored Cuckoo.

*Gen.* Centropus.

*Centropus Philippensis.* Philippine Cuckow.

—— *Gigas ?*

*Tribus* 5. Tenuirostres.

V. *Fam.* Meliphagidæ. *Gen.* Melithreptus, (Vieill.)

*Melitreptus Nova Holandiæ.*

*Gen.* Orcadion, Vieill.

*Orcadion caruncul atus.* Wattled Bee-eater, Lath.

*Gen.* Prinia, Horsf.

*Prinia familiaris.*

*Ord.* III. Rasores.

I. *Fam.* Columbidæ. *Gen.* Treron, (Vinago, *Cuv.*)

*Treron militaris.* Saint Thomas' Pigeon. The Green Pigeon.

II. *Fam.* Phasianidæ. *Gen.* Tragopan, Cuv.

*Tragopan Satyrus.* The Nipal Pheasant.

III. *Fam.* Tetraonidæ. *Gen.* Perdix.

*Perdix Chukar,* Gray. Chukar Partridge.

*Gen.* Ortygis.

*Ortygis Pugnax.* The fighting Quail.

*Ord.* IV. Grallatores.

II. *Fam.* Ardeidæ. *Gen.* Platalea.

*Platalea lencorodia.* The Spoonbill.

*Gen.* Ciconia.

*Ciconia leucocephala.* The Violet Stork, or *Manikjore* of the Natives.

*Gen.* Ibis.

*Ibis falcinellus.* The Green Ibis.

o 2

IV. *Fam.* Rallidæ. *Gen.* Parra.

*Parra Melanochloris.* Indian Jacana.
—— *Chinensis.* Chinese Jacana.
—— *Africana ?*

*Gen.* Porphyrio.

*Porphyrio Indicus.* Indian Porphyris.

*Gen.* Crex.

*Crex porzana.* Spotted Gallinule.

III. *Fam.* Scolapacidæ. *Gen.* Totanus.

*Totanus Glottis.* Green-shank Snipe.

V. *Fam.* Charadriadæ. *Gen.* Vanellus.

*Vanellus macroptera,* Cuv. *V. Tricolor,* Horsf.

*Gen.* Charadrius.

*Charadrius morinellus.* The Dottrel.

*Gen.* Himantopus.

*Himantopus melanopterus,* Tem. Long-legged Plover.

*Ord.* V. NATATORES.

I. *Fam.* Anatidæ. *Gen.* Clangula.

*Clangula Histrionica.* Harlequin Duck.

*Gen.* Fulgula.

*Fulgula rufina.* Red-crested Pochard.

*Gen.* Marcia.

*Marcia cana* (*et Casarca*), Brown. Grey-headed Goose. The Brahminee Duck.
—— *arcuata.* Anas Sili, Ham.

*Gen.* Querquedula.

*Querquedula Crecca.* Common Teal.

IV. *Fam.* Pelecanidæ. *Gen.* Phalacrocorax.

*Phalacrocorax vulgaris.* The Cormorant.

V. *Fam.* Laridæ. *Gen.* Sterna.

*Sterna Hirundo.* The Great Tern.

*Gen.* Diomedea.

*Diomedea exulans.* Wandering Albatross.

I am aware that in the preceding list there are a few omissions and there may be some errors, but I have not at present the opportunity of correcting the one or supplying the other. The list should also have comprised the reptiles, of which the Museum contains some very fine specimens.

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## IX.—EUROPEAN NOTICES OF INDIAN NATURAL HISTORY.

### 1.—*The Dugong.*

The animal sent home preserved in spirits by Mr. G. SWINTON, in 1830, to Mr. J. ROBISON, Secretary of the Edinburgh Royal Society, was delivered over to Dr. KNOX, for dissection. That eminent anatomist writes to Mr. ROBISON in the following terms:

" This very splendid gift to science can be appreciated only by those who, having visited inter-tropical climates and warm countries, generally know well the extreme difficulty of procuring, preserving, and transmitting specimens such as the Dugong, which you have now received from Mr. SWINTON, and which you have done me the honor to place in my hands for examination and dissection.

It may not perhaps be altogether uninteresting to that gentleman to be informed, that two portions of the animal have arrived and have been examined, though in a very cursory way, by me; the shortness of the day and darkness of our climate during the winter months forbidding all attempts at more minute inquiry for the present. These portions are, the head and upper or anterior part of the trunk, including the arms, and seemingly the pyoid bones with the connected soft parts. This portion seems in excellent condition, and will no doubt afford ample scope for dissection; the details of which, together with illustrative sketches, I shall so soon as they are properly arranged and finished, put into your hands, in order to be transmitted to Mr. SWINTON, this being the very smallest return we can make for his so great kindness in transmitting the specimen.

The other portion is the posterior part of the vertebral column and tail; but the middle portion, containing all the viscera, I have not yet seen. It will be readily understood by every anatomist and naturalist, and I hope also by Mr. Swinton, that this division of the animal into three portions was the greatest misfortune which could have happened, since it involved the cutting across so many important parts, the division of all the great vessels and nerves, the displacement of almost all the organs, and the destruction of many; so that it is not to be concealed, that the value of the specimen has been incalculably diminished. It would I fear be presuming too much to hope that the Dugong might one day reach us entire, *in a good state* and *untouched;* inasmuch as the difficulty of procuring these animals is very great, and when taken would require to be immediately placed in a cask of ardent spirits, and carefully enclosed. But however this may be, I shall bestow every pains in my power to make the most of those portions which have already come to hand, and beg to return you and to the Royal Society my thanks for having placed at my disposal an anatomical specimen deemed by me of so great value."

### 2.—*Nepal Specimens.*

[*Extract from the Proceedings of the Zoological Society of London, Jan.* 24, 1832.]

William Yarrell, Esq. in the Chair.

"Specimens were exhibited of various *Mammalia* and *Birds,* collected in Nepâl by B. H. HODGSON, Esq. Corr. Memb. Z. S., British Resident at Katmandoo. For this exhibition, the Committee was indebted to the kindness of Dr. N. WALLICH, to whom the skins had been transmitted by Mr. HODGSON.

The *Mammalia* included specimens of a new species of *Felis,* L.; of two *Antelopes,* one the *Chiru* and the other new to science; and of the wild *Dog* of Nepâl. They were accompanied by colored figures, and, except in the instance of the latter*, by accounts of the several animals from the pen of Mr. Hodgson. These accounts were read.

The new species of *Felis* is described as the *Moormi Cat,* a name derived from that of the tribe which inhabits the part of the hills in which the animal was taken. It was entirely unknown to the natives, and had consequently no local name. It may be thus characterized†.

* This account will be found to be supplied in the 2nd pt. Trans. Phys. Cl. As. Soc.

† Mr. Hodgson's description is given in the GLEANINGS, iii. p. 177.

The only specimen of this species which Mr. Hodgson has been able to procure was a fine mature male, sent to him alive, about two years back, by the Prime Minister of Nepâl; it was accompanied by an intimation that the animal presented to him was the first of the kind ever taken, the people of the country having been by its capture first apprized of its existence in Nepâl. It was caught in a tree by some hunters in the midst of an exceedingly dense forest, situated in about the latitude of the great valley: the *habitat* of the species may therefore be presumed to be the central part of these mountains, or that portion which lies equidistant from the snows of the Himalaya and the hot plains of Hindûstan. Though only just taken when it was brought to Mr. Hodgson, it bore confinement very tranquilly, and gave evident signs of a tractable disposition and cheerful unsuspicious temper; so much so as to convince that gentleman that a judicious attempt at taming it must succeed. None such, however, was made, and when the animal, after six months confinement, died of disease, it was still, of course, unreclaimed from its wild state of manners and temper; in which state it manifested considerable ferocity and high courage, the approach to its cage of the huge *Bhoteah Dog* exciting in it symptoms of wrath only—none of fear.

In a note appended to his description of this second new species of *Felis* from Nepâl, Mr. Hodgson refers to that of the *Fel. Nepalensis*, published by Messrs. Horsfield and Vigors, in the 'Zoological Journal,' vol. iv. p. 383. The ground-colour of this latter animal is there described as "grey, with a very slight admixture of tawny;" whereas in five specimens possessed by Mr. Hodgson, the tawny prevails over the grey to such an extent that the tawny should be regarded as the ground-colour in the mature animal of both sexes. One adult male is almost as brightly tinted as a *Leopard*: the females are paler than the males. He adds that the common species of *wild Cat* is frequently met with in Nepâl of the fullest European size, and so like to the Occidental type as not even to constitute a variety."

The new species of *Antelope* distinguished by Mr. Hodgson as the *Bubaline Antelope*, has been already made known to our readers*.

The skin of the *wild Dog* of Nepâl was compared by Col. Sykes with a specimen of the *Kolsun* of the Mahrattas, recently described by him in the 'Proceedings,' (Part 1. p. 100,) under the name of *Canis Dukhunensis*. He stated his impression to be, that the animals are identical, differing only by the denser coat and more woolly feet of the Nepal race, a difference readily accounted for by the greater cold of the elevated regions inhabited by it. He declined, however, pronouncing a decided opinion, which, he thought, could only be arrived at by more extensive comparison, and by a full acquaintance with the habits of the *wild Dog* of Nepâl.

Among the *Birds* contained in Mr. Hodgson's collection was exhibited a specimen of the *Hæmatornis undulatus*, a species described in the first part of the Proceedings of the Committee, p. 170, and figured in Mr. Gould's 'Century of Birds.' The specimen agreed accurately with that which had been previously exhibited to the Committee, except in size; the present specimen being about one-third larger. From this difference in size it was conjectured to be a female. Specimens were also in the collection of the *Myophonus Temminckii*, the difference between which species and the *Myophonus flavirostris* (*metallicus*, Temm.) had been pointed out in

* Vide Gleanings, iii. 122.

the same part of the 'Proceedings,' p. 171. The separation of the two species was thus further justified by the accurate accordance of several specimens of the Nepâlese bird, in those characters which separated them from the Archipelagan species. A specimen of *Zoothera monticola* was also included in the exhibition, which deviated in no respect from that already described in the 'Proceedings,' p. 172, and figured by Mr. Gould.

An interesting species of *Hornbill*, which has been described by Mr. Hodgson in the 'Asiatic Researches,' vol. xvii. p. 178, but which had never before been seen in Europe, accompanied the former birds.

Among some drawings of this species which accompanied the collection, one was observed in which the tail was elevated in the same manner, although not to the same extent, as in the *Toucans* of South America when at rest. Mr. Vigors called the attention of the Committee to this peculiarity in the *Toucans*, which he had ascertained from a living bird in his own collection, and which he described in the 'Zoological Journal,' vol. ii. p. 480, pl. xv. And he dwelt on the additional proof thus afforded of affinity between these two families of the Old and New World, which are equally allied by the most important characters of their structure.

A male and female *Pheasant* were also exhibited from the collection, which appeared to be the species described by Dr. Latham under the name of *Phasianus leucomelanos*, (Ind. Orn. ii. 633.) Mr. Vigors pointed out the difference between this species and the *Phasianus albo-cristatus*, which he had described in the first part of the 'Proceedings,' p. 9. This difference consisted in the deep black colour of the crest in the *Phas. leucomelanos;* in the lanceolated feathers of the under part of the body extending no further than the breast; and in the plumes of the lower part of the back being doubly fasciated, by a slender violet-black band in the first instance near the *apex*, and secondly by a slender white apical band. In the *Phas. albo-cristatus*, on the contrary, the crest is white, with a somewhat dusky base; the lanceolated feathers on the under body extend over the abdomen; and the feathers on the lower part of the back are fasciated with one rather broad white apical band, without any vestige of the black violet markings observed in the other species. Mr. Vigors added, that these two species, together with the *Phas. lineatus* of Dr. Latham, exhibited to the Committee on the 11th Jan. of last year, and described in the 'Proceedings' of that date, p. 24, as well as the *fire-backed Pheasant*, *Phasianus ignitus*, Lath., formed a group among the *Pheasants*, which appeared intermediate between the typical birds of that family and the genus *Gallus*, or *Jungle Fowl*. This group, distinguished by their crests, and by the tail partaking equally of the elevated character of that of the *Jungle Fowl*, and the recumbent character of that of the *Pheasant*, had been set apart by MM. Temminck and Cuvier under the name of *Houppiferes*, and by the former naturalist under the scientific name of *Euplocamus*.

The only species apparently undescribed in the collection was the following *Pigeon*, which Mr. Vigors expressed his pleasure in having it in his power to dedicate to the enterprising and scientific discoverer.

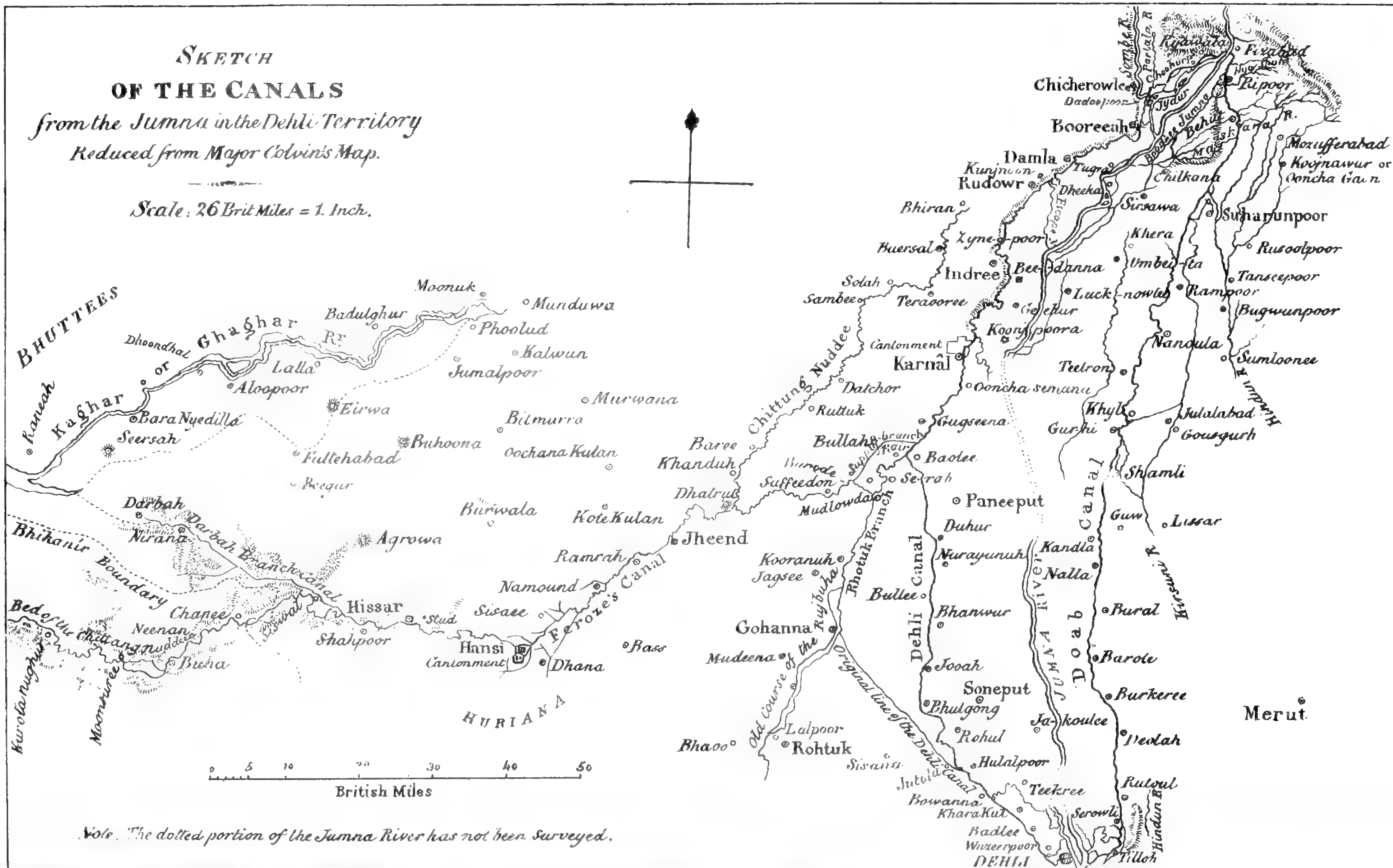
Columba Hodgsonii. *Col. capite colloque pallidè, dorso crissoque intensiùs vinaceo-griseis; alis, regione interscapulari, abdomineque vinaceo-brunneis, hoc albo variegato; scapularibus albo guttatis; nuchâ vinaceo-brunneo notatâ; remigibus rectricibusque, his intensius, fuscis; gulâ albescenti-griseâ; pedibus saturatê cæruleis, unguibus flavis.*

Longitudo *corporis*, 15 unc.

## *Meteorological Register kept at the Assay Office, Calcutta, for the month of February,* 1833.

| Day of the month. | Barometer reduced to 32° Farh. | | | | Thermometer in the Air. | | | | | Depression of moist-bulb Thermometer. | | | | Hair Hygrometer. | | Rain. | Wind. | | | Weather. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 5 A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | Minimum at 5 A. M. | At 10 A. M. | Max. by reg. Ther. | At 4 P. M. | At 10 P. M. | At 5 A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | At 10 A. M. | At 4 P. M. | Inches. | Morning. | Noon. | Evening. | Morning. | Noon. | Evening. |
| 1 | 29,989 | ,056 | ,950 | ,040 | 64, | 71,6 | 83,6 | 76,0 | 69,8 | 3,0 | 5,9 | 10,5 | 5,8 | 92 | 81 | | o. | n. | o. | clear all day. | | |
| 2 | 30,008 | ,054 | ,940 | ,021 | 67, | 71,0 | 83, | 77,4 | 70,0 | 2,6 | 4,3 | 9,9 | 3,9 | 95,5 | 85 | | o. | w. | s. e. | fog. | clear. | clear. |
| 3 | 29,967 | ,030 | ,920 | ,006 | 67, | 71,5 | 83,8 | 77,8 | 71,5 | 2,4 | 5,5 | 10,1 | 5,6 | 92 | 83 | | o. | n. e. | e. | ditto. | cir. | cir. |
| 4 | ,977 | ,023 | ,900 | ,964 | 68,8 | 72,6 | 83,6 | 78,0 | 69,4 | 5,8 | 6,8 | 11,0 | 6,2 | 90 | 82 | | o. | n. | n. | clear. | ditto. | ditto. |
| 5 | ,920 | ,976 | ,810 | ,853 | 65,7 | 70,3 | 83,4 | 75,7 | 68,2 | 3,7 | 5,3 | 9,0 | 3,2 | 93 | 87 | | n. w. | n. e. | o. | cum. | cum. | cloudy. |
| 6 | ,822 | ,891 | ,812 | ,892 | 64,5 | 73,2 | 81,8 | 76,2 | 69,2 | 2,8 | 6,5 | 8,9 | 3,5 | 91 | 86 | 0,10 | o. | o. | e. | ditto. | ditto. | clear. |
| 7 | ,917 | ,950 | ,850 | ,945 | 63,5 | 72,8 | 83,0 | 76,2 | 67,9 | 6,0 | 14,5 | 17,8 | 10,1 | 75 | 68 | | w. | n. | w. | ditto. | clear. | clear. |
| 8 | ,942 | ,981 | ,870 | ,925 | 63,1 | 71,0 | 80,5 | 77,2 | 68,0 | 8,1 | 10,2 | 16,0 | 5,7 | 82 | 67 | | o. | n. | s. w. | ditto. | ditto. | ditto. |
| 9 | ,913 | ,976 | ,828 | ,884 | 60,3 | 72,0 | 82,6 | 78,2 | 67,3 | 5,0 | 8,0 | 14,8 | 5,3 | 84 | 70 | | o. | w. | w. | ditto. | ditto. | ditto. |
| 10 | ,846 | ,843 | ,732 | ,841 | 67,5 | 73,0 | 83,4 | 79,1 | 73,3 | 2,5 | 6,0 | 10,1 | 4,6 | 90 | 80 | | o. | n. w. | n. w. | cis. | ditto. | cir. |
| 11 | ,782 | ,845 | ,729 | ,878 | 70, | 75,2 | 82,3 | 80,2 | 71,2 | 2,8 | 4,3 | 8,2 | 3,9 | 95 | 90 | | e. | n. e. | s. e. | stratus. | cum. | nimbus. |
| 12 | ,851 | ,943 | ,835 | ,934 | 69, | 73,9 | 85,0 | 78,0 | 72,0 | 3,2 | 6,6 | 11,6 | 5,9 | 90 | 80 | 0,08 | o. | n. e. | o. | clear. | ditto. | gathering. |
| 13 | ,936 | ,996 | ,886 | ,025 | 69,2 | 74,5 | 84,4 | 78,4 | 69,6 | 4,4 | 9,3 | 16,0 | 7,2 | 82 | 65 | | o. | n. w. | n. w. | ditto. | ditto. | cl. [N. E. |
| 14 | 30,005 | ,009 | ,890 | ,025 | 68,2 | 74,2 | 82,3 | 78,8 | 71,0 | 8,1 | 12,5 | 16,5 | 6,8 | 75 | 71 | | o. | n. w. | e. | ditto. | clear. | ditto. |
| 15 | 29,983 | ,012 | ,865 | ,959 | 66,5 | 73,3 | 82,4 | 78,5 | 69,3 | 6,3 | 13,7 | 17,0 | 9,0 | 74 | 67 | | o. | w. | s. w. | ditto. | ditto. | ditto. |
| 16 | ,967 | ,988 | ,871 | ,978 | 62,8 | 72,8 | 81,3 | 78,8 | 66,7 | 4,6 | 15,5 | 18,3 | 8,1 | 69 | 64 | | o. | n. w. | o. | ditto. | ditto. | ditto. |
| 17 | ,955 | ,998 | ,830 | ,976 | 64,3 | 73,2 | 83,2 | 79,2 | 70,2 | 6,3 | 10,4 | 15,1 | 6,0 | 72 | 80 | | o. | o. | o. | ditto. | ditto. | ditto. |
| 18 | ,923 | ,975 | ,825 | ,971 | 66,6 | 73,8 | 81,0 | 79,6 | 69,6 | 2,7 | 8,4 | 7,9 | 3,5 | 83 | 90 | | s. w. | s. w. | s. | ditto. | cum. | cloudy. |
| 19 | ,974 | ,025 | ,920 | ,023 | 68,2 | 74,6 | 83,2 | 78,9 | 73,2 | 2,1 | 4,6 | 7,5 | 3,5 | 95 | 92 | 0,30 | o. | n. w. | n. | ditto. | cu. st. | n. wester. |
| 20 | ,980 | ,029 | ,897 | ,989 | 69,4 | 75,0 | 83,7 | 79,2 | 75,1 | 1,0 | 3,9 | 6,7 | 4,0 | 97 | 94 | | o. | o. | n. | fog. | cu. | cum. |
| 21 | ,925 | ,964 | ,827 | ,964 | 70,2 | 76,1 | 83,8 | 79,8 | 74,5 | 3,5 | 7,6 | 10,1 | 7,5 | 91 | 84 | | s. | n. w. | n. | ditto. | clear. | clear. |
| 22 | ,956 | ,920 | ,803 | ,934 | 71,2 | 75,2 | 83,1 | 80,2 | 74,7 | 5,9 | 7,2 | 12,0 | 9,3 | 91 | 81 | | o. | n. e. | o. | clear. | ditto. | ditto. |
| 23 | ,869 | ,933 | ,793 | ,886 | 68,4 | 76,2 | 83,0 | 80,0 | 75,0 | 4,0 | 7,7 | 10,9 | 4,2 | 89 | 84 | | s. | n. e. | s. w. | ditto. | cum. | cum. N. |
| 24 | ,874 | ,920 | ,800 | ,948 | 72,1 | 76,8 | 83,8 | 81,4 | 76,4 | 2,1 | 8,2 | 10,7 | 4,2 | 89 | 86 | | s. | n. e. | n. | ditto. | ditto. | cloudyS.E. |
| 25 | ,901 | ,940 | ,821 | ,943 | 72,5 | 77,1 | 84,8 | 82,8 | 75,5 | 1,7 | 8,9 | 10,2 | 4,2 | 89 | 87 | | o. | n. e. | o. | ditto. | clear. | clear. |
| 26 | ,903 | ,934 | ,784 | ,908 | 67,5 | 76,7 | 86,0 | 84,2 | 73,4 | 2,2 | 9,8 | 15,9 | 3,4 | 85 | 71 | | s. e. | n. | n. | ditto. | ditto. | ditto. |
| 27 | ,896 | ,928 | ,836 | ,960 | 72,1 | 77,9 | 87,0 | 85,7 | 74,8 | 3,7 | 8,2 | 23,3 | 11,3 | 87 | 55 | | s. | w. | o. | cum. | ditto. | ditto. |
| 28 | ,940 | ,997 | ,826 | ,938 | 71,4 | 77,9 | 86,9 | 83,7 | 74,7 | 2,8 | 9,5 | 18,9 | 6,7 | 85 | 59 | | s. w. | n. w. | o. | foggy mist | ditto. | ditto. |
| Means | ,925 | ,969 | ,844 | ,951 | 67,5 | 74,0 | 83,5 | 78,7 | 71,5 | 3,9 | 8,2 | 12,7 | 5,8 | 86 | 78 | 0,48 | light airs. | | | generally fine. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory. Those for 5 A. M. and 10 P. M. are placed in a south veranda near the Cathedral. The Barometers stand ,020 lower than the Surveyor General's instrument.


SKETCH
OF THE CANALS
from the Jumna in the Dehli Territory
Reduced from Major Colvin's Map.
Scale: 26 Brit Miles = 1 Inch.
BHUTTEES
Kaghar or Ghaghar Rr
Raneah
Dhoondhal
Bara Nyedilla
Seersah
Aloopoor
Lalla
Badulghur
Moonuk
Munduwa
Phoolud
Kalwun
Jumalpoor
Eirwa
Fultehabad
Buhoona
Murwana
Bilmurra
Oochana Kulan
Buriwala
Kote Kulan
Agrowa
Darbah
Nirana
Darbah Branch Canal
Bhikanir Boundary
Chanee
Neenan
Bed of the Chittang nuddee
Busia
Kurotanughul
Moonurree
Hissar
Stud
Shahpoor
Sisaee
Namound
Ramrah
Feroze's Canal
Jheend
Hansi
Cantonment
Dhana
Bass
HURIANA
Baree
Khanduh
Dhatrut
Chittung Nuddee
Rutluk
Datchor
Solah
Sambee
Teraooree
Buersal
Bhiran
Indree
Zyne-poor
Bee-danna
Rudowr
Kunjnoon
Damla
Tugra
Dheeka
Escape
Booreeah
Chicherowlee
Dadoopoor
Sombe R.
Partala R.
Jydur
Boodee Jumna
Behut
Fyzabad
Ripoor
Sirsawa
Chilkana
Suharunpoor
Mozufferabad
Koojnawur or Ooncha Gaon
Rusoolpoor
Tanseepoor
Rampoor
Bugwunpoor
Sumloonee
Hindun R.
Khera
Umbeita
Luck-nowlee
Gejellur
Koonjpoora
Nandula
Cantonment
Karnal
Teelron
Ooncha semana
Gugseena
Bullah
branch
Baolee
Suffeedon
Serah
Mudlowda
Paneeput
Khyli
Gurhi
Julalabad
Gousgurh
Shamli
Gum
Lissar
Kirsuni R.
Duhur
Kandla
Nalla
Canal
Doab
Nurayunuh
Kooranuh
Jagsee
Rajbuha
Rhotuk Branch
Bullee
Dehli Canal
Bhanwur
Gohanna
Mudeena
Old course of the Rajbuha
Original line of the Dehli Canal
Jooah
Soneput
Bhulgong
Rohul
Jumna River
Jakoulee
Bural
Barole
Burkeree
Dedah
Merut
Lalpoor
Rohtuk
Bhaoo
Sisana
Hulalpoor
Teekree
Bowanna
Kharakui
Badlee
Wuzeerpoor
DEHLI
Serowli
Rutoul
Hindun R.
Tilloh
0 5 10 20 30 40 50
British Miles
Note. The dotted portion of the Jumna River has not been surveyed.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

*No*. 15.—*March*, 1833.


## I.—*On the Restoration of the Ancient Canals in the Delhi Territory.* *By* Major Colvin, *Engineers.*

[Extracted from that Officer's Report to Government as Superintendent of Canals.]

### I. THE CANAL OF FEROZ SHAH.

The original branch of the canals lately re-opened, to the west of the *Jamna*, was excavated under Feroz Shah, about the middle of the fourteenth century. The neighbourhood of *Hissar* was his favorite hunting ground, where he evidently must have passed much time, attended by his court, if we may judge from the extensive ruins of buildings and tombs still existing, and occupying a space of several square miles, all attributed to that period; the advantages of an abundance of good water for so large an assemblage, in a country of such extreme aridity, where the wells are 130 feet deep, and the springs often salt, may have been the principal incentive to this great undertaking.

Probability and tradition point out the head of the original canal to have been where it now is, immediately at the point where the *Jamna* issues from the lower range of hills, and nearly opposite to another hunting seat of the same emperor, marked in the maps as *Bádsháh Mahal*; from whence it was apparently conducted along one of the many old water-courses of the *Jamna*, till it fell into what was then the mouth of the *Súmbe* river*. This channel, under the operation of time and floods now become the western branch of the *Jamna*, was then probably

* A mountain-torrent nearly dry, except in the rains, when it receives the drainage of the mountains south-east of *Nahun*, and of the plains east of its course, nearly to the *Jamna*, from which and a strong fall, its floods are most violent and sudden in their effects.

of more moderate dimensions, and, to turn the water into the cross-cuts formed, must have been closed below *Fattehgarh,* probably by an earthen dam renewed annually, no remains whatsoever of any permanent work remaining in that vicinity. By one or other, or all of the channels, the remains of which now exist, the water was conveyed across a tongue of land into what is clearly another old channel of the *Jamna* under *Búrya,* being a wide hollow, skirting the high ground to its north and west, which is continuous, though with numerous and deep indentations, from the hills along the right bank of the *Súmbe* river, and then following this water-course as far as *Karnál;* towards the hills rising little short of 100 feet, and sinking south of *Karnál,* near *Uncha Sumáná,* (where the canal enters on the high land, and diverges from the *Jamna,)* to about 15 feet. Above this point the land on the left bank is uniformly low, extending to and forming the *Kádir* land of the *Jamna,* a most fertile tract, almost entirely under cultivation, and from its composition, and the closeness of water to the surface, almost independent of irrigation.

From *Uncha Samáná,* a canal must have been excavated, at first of great depth, but gradually diminishing as it approached *Suffí-don,* near which it opened into a branch of the *Chítang* river, said to come from near *Teraúrí* by *Baród,* a few miles east of *Suffídon**, along which the canal was led with partial excavations, of which the remains exist, in some places more, in others less, (as would be the case in clearing out a river bed,) until it rejoined the other branch of the *Chítang,* at *Dhátrat.* From *Dhátrat* the marks are more apparent of its having been an ancient river bed, simply cleared out to pass on a stream of water to *Hissár,* and a few miles beyond the latter, apparently with a view to provide an escape for the surplus water of the canal into the old bed of the river; as within a few miles of *Hissár* all trace of former excavation ceases, whilst the river bed is continuous; latterly, winding among the sand hills of *Bhikanír,* or more properly speaking, along the northern bounds of the sandy desert†, until the bed unites with that of the *Ghaghar* river, near *Badhopal,* and about 22

* Of this branch all I am aware of is, that in heavy seasons of rain great floods pour into the canal near *Baród,* said to be consequent on the destruction of the earthen dams of the *Chítang.*

† The grounds of this remark are, that south of the bed of the *Chítang* the country is merely a succession of hills, and swells of sand, in some parts rising 200 feet, whilst to the north the sand is chiefly in detached ridges and patches; the sub-soil, when it gets clear of the drift sand, being a hard flat, covered with low tree jungle, totally different from the sandy desert of *Bhikanír.*

miles south-east of *Bhatnír,* whence it has been traced by Mr. W. Fraser to open on the valley of the *Satlej,* north-east of, and about 20 miles from *Baháwalpúr ;* thus securing an outlet for the waters, should such ever be needful: but as the *Ghaghar* river, which receives the drainage of the hills from *Náhan* to *Plassía,* and generally of the country between the *Jamna* and the *Satlej,* does not in the heaviest season pass in force beyond *Bhatnír,* no stream by the *Chítang* is likely to effect the junction, and the period when this river ceased to flow as one is far beyond record, and belongs to the fabulous periods of which even tradition is scanty.

It may not be out of place here to advert to the causes which are even now operating to destroy the utility of the *Ghaghar* and such rivers, and tending to extend the limits of the desert, which forms our north-western boundary in this quarter. What the country about and west of *Ráneah,* now inhabited by the *Bhattís,* has been, may be inferred from the numerous sites of towns and villages scattered over a tract, where now fixed habitations are hardly to be met with. I allude only to the vicinity of the bed of the *Ghaghar,* with which I am personally acquainted;—when the depopulation took place, I am not prepared to say; it must have been long since, as none of the village sites present one brick standing on another, above ground,—though, in digging beneath it, very frequent specimens of an old brick are met with, about 16 inches by 10 inches, and 3 inches thick*, of most excellent quality: buildings erected of such materials could not have passed away in any short period. The evident cause of this depopulation of the country is the absolute absence of water, most probably the effect of the system now in use in the Sikh states, through which all these rivers pass from the mountains;—namely, the erection of dams of earth across the streams at all favorable points, to raise the water so high as to flow over the face of the country and irrigate it, the surplus escaping by the sides till stopped by other dams, and so on, it might almost be said, ad infinitum.

It will easily be conceived, that in forming this string of lakes, the consumption of water by absorption and evaporation disposes of the greater portion, whilst the irrigation takes a very small share, which could be equally well, though more expensively, drawn off by small canals from the main stream, leaving the latter open to proceed onward

* Such bricks were all found marked thus evidently by a revolution of the fingers extended with the thumb as a centre, and gradually drawn round and up to the thumb. Similar bricks of an age anterior to the Mahomedan conquest, have been excavated at *Hansi.*

as far as it would go, and such an unincumbered stream would by being in constant action prevent the accumulation of impediments in the river bed, which, under the system of damming, have eight months of each year to accumulate, and in a country liable to drift sand, any vegetation in the bed is sufficient to collect and stop it, and form banks, which from the effect of the next rains is spread and deposited in hollows, gradually raising the bottom, and thereby widening the water way, and diminishing its power of sweeping clean the channel—an operation which with an open river would have been constantly going on, as no particle of water passes onwards without moving somewhat nearer to its final receptacle some portion of the river silt. In the *Ghaghar*, the outlet no longer existing, the operation is that of a gradual filling up from the tail of the river upwards, and the consequent shortening of the point to which water reaches from its source. At present the stream in the dry weather reaches to *Dúndhal*, and it is only in the rains that any portion of water reaches our provinces when heavy floods sweep along the bed of the *Ghaghar*, sometimes as far as *Bhatnír*, and convert all the hollows into lakes, which are gradually shoaling, by the amount of silt in the water filled into them. The bed of the river, thus saturated and aided by irrigation from the patches of water, yields the most splendid crops of wheat in the neighbourhood of *Ráneah* (a space several miles wide)—a benefit our landholders must lose as the river retrogrades, but which might be much extended, as was shown the year we occupied the *Bhattí* country, when, a number of the lower dams being cut, the floods of the rains reached and passed *Ráneah* in abundance, where they had hardly been for years previously. The most beneficial effect of insisting on a right to a share of the waters which do not rise in, but only pass through, the Sikh states, would be in affording a sufficient supply of water for the *nala* or canal from the *Ghaghar*, at *Múnok*, into it again near *Ráneah*. The general line of it is shown on the map passing by *Fattehábád*, and being in a great measure within our frontier, it would be an extension of the benefits of irrigation from the *Ghaghar* to our own subjects, who now derive so little from the vicinity of what the acts of our neighbours make but a nominal river nearly. This old water-course is well defined at its head, and so far open that, in the rains, the freshes send down a supply of water for the rice cultivation near *Fattehábád*. FEROZ SHAH is said to have made a canal from the *Ghaghar*, and it is possible that this is the channel alluded to. The advantages of its being re-opened (only however after the *Ghaghar* river shall have been cleared of dams, for at least 100 miles up) should not be lost sight of. The only thing further I have to say on the canal of

FEROZ SHAH is, that as no marks of irrigation channels exist along its banks, it is natural to suppose no system of extensive irrigation had time to take root, and that, with the decease of its founder, it fell into neglect, and discontinued flowing; had it flowed long enough to get up any system of irrigation, the remains of water-courses would not have been utterly obliterated, whereas there are no traces of them west of *Suffídon.*

### ALI MARDAN KHAN'S, OR, THE DELHI CANAL.

Whether the above canal continued to have a stream in any part of its course or not, at the time the Delhi branch was thought of, early in the seventeenth century, does not seem very clearly known; though the expression of ALI MARDÁN KHÁN "having brought his canal from *Karnál* to *Delhi*" would imply that, the original canal still flowed as far as *Karnál*, and thence probably into the *Jamna*, from the choaking up and neglect of the excavated portion between *Karnál* and *Suffidon.* Anxiety to take advantage of the ancient canal of FEROZ SHAH, so far as suitable in direction, probably induced ALI MARDÁN KHÁN to follow it as far as *Madloda*, whence turning south, he would fall in with a natural hollow near *Korána*, which is in fact the head of a great drain of the country ending in the *Farkhnagar Jhíl*, about 15 miles S. W. of *Delhi*, and this he unfortunately followed to *Gohána.* Thence diverging south-east, he appears to have pursued a line, the traces of which are most prominent from *Gohána* to *Jatola;* and thence on, or nearly on, the present line, he made his way to *Delhi.* A terrible catastrophe is recorded to have happened on the first trial of the works, when the water, having got into the deep hollow at *Gohána*, could not escape thence by the channel formed, and accumulating, until it overtopped the embankments across this hollow way, destroyed the town of *Lálpúr*, of which the extensive ruins still exist in a low hollow west of the present town of *Rhotak.* The correction* of his error appears to have been made with much judgment, passing closely to the natural ridge of the country, where the land falls off on each side. From *Jatola*, the departures from his old course are of less moment; although, to account for the remains of bits of canal here and there, he must have made another detour near *Bhowána*, where entering on the low ground between that and the rise on which the city stands, he had his most difficult task. He appears to have secured himself, by an outlet, at the upper end of this dangerous spot, sufficient to reduce the level of canal materially in case of accident. Ahead of this point to maintain the level required in the city and palace, the canal, instead of

* By excavating anew from near *Rair* to *Jatola.*

being sunk in the ground, is carried along an elevated mound, in many parts of which the bottom rises much higher than the surrounding country. The lowest portion of this hollow was crossed on an aqueduct of masonry, under which escapes the surplus water of the *Farkhnagar Jhîl* into the *Jamna.* The canal, shortly after entering on and skirting the base of the range of hills west of *Delhi* (the drainage from which crosses over the canal by ancient aqueducts), is finally led directly across the ridge by a channel cut out in the rock, to the depth of about 60 feet at the crest. It then enters the city, and passing through it by an open channel, traverses along another extensive aqueduct into the palace, throughout the whole of which it ramifies, in open or covered water-courses, having outlets to the *Jamna,* thus permitting the passage of constant streams of fresh water. Similar to these, in the space between the range of hills and the palace, numerous underground channels were led off to the various residences of the nobles, and the divisions of the city, yielding to the whole city and its suburbs a supply of good water, from the open well shafts connected with these underground water-courses, and necessary to admit of their being cleared out.

On a review of the ancient works in *Delhi,* connected with the canal, money must have been expended with a most lavish hand, to effect what is known; and much is yet hidden in the ruins of the neighbourhood. The branch thus successfully opened, appears to have been maintained in a state of efficiency, until the year 1760, including a supply down the *Gohána* branch, and another down a portion of FEROZ's canal, in which latter the water ceased to flow at *Suffídon* about 1740. The decay of the canal was probably gradual; and final only, when the power of the emperor was too much circumscribed, and his attention too much engaged by the perilous circumstances of his reign, to attend to such matters : to which may be added the gradual increase in size and depth of what was then the western branch of the *Jamna,* rendering the annual formation of the earthen dam across it in time for the irrigation of the crops, a work of more difficulty and labor, than was compensated by the advantages derived. During the long period that it did flow, the system of irrigation from its waters appears to have been most extensively diffused, judging from the multitudes of water-courses which intersect the country on both banks, from below *Karnál* to *Delhi* : the amounts of the revenue derived from it must however be deemed fabulous, or must be misunderstood;—villages, which have from 12 to 15,000 *bigas* of land, being stated to have paid a lakh of rupees a year—a sum about equivalent to the gross produce of the land, supposing every part of it yielded one first-rate crop annually, and that the whole of the lands were under irrigation, a matter for which the capacity of the canal was perfectly inadequate. Either the price of produce must have been much higher then, or the village bounds much more extensive; or what is more probable, districts were designated by the names of the principal towns or villages, and thus the rents stated include the total revenues. Certainly no such results are now witnessed in villages of the first magnitude, where irrigation is used to the extent of 1500 Rs. per annum for the use of the water. One such village, *Bhatgaön*, yields the Begum Sumroo 20,000 rupees a year, I believe; and another, *Sissana*, pays, I think, to our Government 16,000 rupees. Another, *Korána*, pays about 14,000 rupees, and is one of our finest villages on the canals, though not so large as others: these villages irrigate extensively*.

THE DOAB CANAL OF ALI MARDÁN KHÁN.

I am less acquainted with the former history of this canal. It certainly bears the name amongst others of ALI MARDÁN KHÁN, and must therefore be coeval with the *Delhi* canal; but having undergone several reparations in parts, its names are various. It was originally led from the *Jamna* shortly above the ruins of *Bádsháh Mahal,* along a *nala* of the *Jamna* to the village of *Nya Shahr,* from which an excavated channel conducts it into a small mountain-torrent near *Raipúr,* in which it proceeds about two miles, and is then led slanting across the beds of two great mountain-torrents, (the *Nyagaön* and *Maskareh Rao;)* on getting clear of which, it was led by *Sahāranpúr,* apparently along the crest of the ridge between the *Jamna* and *Hindan* rivers, from the feeders of the latter leading off from its left or east bank; whilst it is ascertained that several hollow ways lead towards the *Jamna* from its right bank. In its course from *Sahāranpúr* to near *Delhi,* there is nothing particular to notice, beyond the absolute absence of the remains of any trace of ancient bridges or water-courses. Near *Delhi,* it descends into the valley of the *Jamna,* and passing partly direct, and partly through the grounds of a Royal preserve, it rejoins the *Jamna* opposite the city. From the above-mentioned want of traces of ancient works, I conceive the task of maintaining the passage across the mountain-torrents at its head, of which three are first-rate, was found to be so great, that the canal was abandoned almost as soon as formed, and that the repeated attempts at reparation afterwards were only

* In these sums I do not pretend to perfect accuracy: they are noted from recollection. *Bhatgaön* and *Korána* are two of those stated to have yielded a lakh of rupees a year.

efficient for a season, and were overcome by the increasing difficulties. Had irrigation existed to any extent, 100 years could not have obliterated all traces of it; and had the water flowed for any length of time, results analogous to what are now experienced elsewhere would have followed, and must have left a trace behind them. Of the former condition of this canal, I must therefore content myself with these inconclusive remarks.

*Restoration of the Canals in the Delhi Territory.*

The attention of Government seems to have been drawn to the canals shortly after these provinces came under our dominion. I have understood the first suggestion was the offer of a gentleman (Mr. MERCER) to re-open the *Delhi* canal at his own expence, under the engagement of having secured to him the *whole* benefits resulting for a period of 20 years, which was not accepted; and under orders of Government, a survey and design for the work was completed and submitted for consideration by Lieut. MACARTNEY, of the Cavalry, in the year 1810; this was further followed up, if not preceded, by several reports from other officers on the subject; (Lieut. WHITE of the infantry and Lieut. FORDYCE of the engineers, amongst the number,) whose reports are lodged in the Chief Secretary's Office: and the whole subject seems to have elicited such a variety of opinion from Colonels KYD, GARSTIN, and COLEBROOKE, either as Surveyors General or Chief Engineers, that the matter seems to have fallen into abeyance, until revived during the government of the MARQUIS OF HASTINGS. In the same year, a survey of the *Doab* canal was made by Lieut. TOD, followed up by a notice from Lieut. HODGSON, from which nothing resulted. The canal of FEROZ SHAH is merely incidentally noticed, and appears not to have engaged any attention until the period of Captain BLANE's appointment to the canals. I am unable to give any special notice of what may be called the preliminary measures, from the want of records in my office, where nothing further than the original reports by Lieuts. MACARTNEY and TOD exist.

*Restoration of the Delhi Canal, from the Hills to Delhi,* 185 *miles in length.*

This subject appears to have early engaged the attention of the MARQUIS OF HASTINGS, although it was not till the beginning of 1817, that Lieut. BLANE of the engineers was appointed to conduct the work; his estimate was framed on the report of Lieut. MACARTNEY: although in the progress of the work, it was found necessary to depart considerably from the ideas of that officer, in consequence of the changes effected by the river in this interval. The work was carried on by Lieut. Blane, with great zeal and in the face of numerous difficulties, and the water being partially brought down as the work progressed, irrigation commenced from it in 1819, and by the end of May, 1820, the water was brought to the city of *Delhi*, and passing through the main conduits in the palace, rejoined the parent stream.

Lieut. Blane, instead of drawing his supply of water from the river by any of the old heads near *Búrya*, or as pointed out by Lieut. Macartney, from near *Dadúpúr*, (either of which, in the then state of the case, would have entailed the closing up of what had become the western branch of the *Jamna*, either by a permanent work eminently liable to destruction, or by an earthen dam renewed annually, at a great expence and loss of time, besides the almost certainty of its destruction, from the floods of the cold weather,) wisely selected the vicinity of *Chúharpúr*, to draw the supply from, although it entailed the passage of two rivers, one the *Patralla*, of no great moment, the other the *Súmbe*, of considerable difficulty, from its being the sole drain of the mountains south-east of *Náhan* nearly down to the *Jamna:* these two rivers between them drain also the whole country nearly between the *Súmbe* and the *Jamna*, and as their streams united before reaching the *Jamna*, one crossing would be saved. He unfortunately drew his new line of canal from the junction to *Búrya*, too close to the *Jamna*, instead of leading it under *Bellachor* and *Kharwán*, which though much more expensive in the onset, would have proved less so hereafter; it would at least have been much safer, as it has now become necessary to take measures against the encroachments of the *Jamna**, which this season have been to a formidable extent, and may this year, require expensive means, to prevent its continuance, which can only be decided on after the rains. The water led from the *Jamna* near *Chúharpúr* is conducted along a

* The effects of this, supposing the *Jamna* to cut into the canal, may be here noticed: the present bed of the canal *is above* the low-water surface level of the *Jamna;* the fall of the *Jamna* is more rapid than that of the canal, the level of the latter being maintained to attain the upper surface level of the country, and the maximum rise of the *Jamna* would suffice to throw about 12 feet water into the canal at height of floods; this would probably cause much damage in times of heavy floods, and might permanently be injurious by sweeping out the bed, and inclining the river to take this course from its lying direct in the line of current. In such case, it would break into the river again either at *Kanjnún*, or at *Kárnal*, or both, and its strength of current would suffice to clear for itself such a channel as would remedy the evils it could not fail to bring about in the meantime. The superior slope of the bed of the Jumna is likely to prevent this, and means may be devised to lead off the strength of the current from the bank, it has this year so fiercely attacked.

natural channel to *Jhydarí,* thence by a new cut into the *Patrálla,* which it follows to its junction with the *Súmbe,* where Lieut. BLANE projected a dam of masonry, but was deterred from its execution by the heavy floods of 1820: the earthen dam then required was in extent 500 feet, now it has extended to a serious work of 1200 feet; the extension is attended with the advantage of the floods attaining less height, as none have reached since within three feet of the height he noted.—From this point an entirely new channel connected this work with the old line of canal near *Búrya,* whence its bed was simply cleared or restored as far as *Delhi;* in the vicinity of which a number of old bridges were repaired and some new ones built, besides which the only other works done were the formation of a new escape dam at *Kanjnún* towards the head of the canal, and the restoration of an old one near *Bowána,* for the tail of it; both works of vital importance, though still insufficient from want of a more centrical escape (as at *Karnál*), to pass off the heavy land floods from the north of *Karnál,* which are added to those of the canal in the rains: the old channel by *Búdakhera* presents a suitable site for such a work. On Lieut. BLANE's unexpected death in June, 1821, the canal was considered finished, and the bills rendered, amounting to somewhat more than half of the estimate—many works noted in them were not even commenced. The canal was however in fact completed, so far as conducting the supply of water then needful was concerned. When this supply came to be increased, and that for FEROZ's canal to be also brought down by the same head, the canal was no longer efficient; to prevent inundation, it became necessary to embank the canal nearly from end to end, and when the water became so deep as not to admit of a loaded hackery (or cart) passing through it, it became necessary to build bridges, so that from within a few years of Captain BLANE's death, the works of the canal, suited to its present purposes, have been in almost constant progress, and upon an enhanced scale, from the canal being kept full of water during their execution; for the irrigating villages had then become dependent on it for the means of paying their revenue. These works are only now drawing to completion.

*Restoration of Feroz's Canal. Main branch, Rair to Baháderah,* 151¼ *miles in length; Rhotak branch,* 45 *miles long; Darbah branch,* 32 *miles long; New Supply Head,* 12 *miles long. Total length,* 240 *miles.*

The idea of the advantages of this work appears to have presented itself to the mind of Captain BLANE, when employed on the *Delhi* canal, in its vicinity; but they were first specifically brought to the consideration of government by the civil commissioner Mr. FORTESCUE, through whom I received instructions in May, 1820, to make the requisite surveys and estimates; these added to other duties were not completed till June, 1822, and were then submitted to government, and sanctioned during that year; and I was honored, by being appointed to carry my own ideas into effect. The work commenced in March, 1823; the excavation of the channel was completed, and, a few necessary works of masonry for regulating the water being finished, the water was turned down the canal in May, 1825. This measure may appear precipitate, but water to the country, to which this was destined, was so valuable a boon to both man and beast, and the soil was generally so good, and the canal relatively to the *Delhi* one so small, that the extra expence of working in water was of much less moment, than the benefits of the supply of water to the country. Since that period the completion of original works, as well as the extension of the advantages of the canal, have been progressive.

The original works consisted in the clearance of the old line of canal from *Rair* to *Chaminí*, with the formation of bridges, as detailed in the abstract of estimates. The extensions are of the main line to *Bahúderah*,—of an additional branch into our newly settled frontier towards *Darbah*,—and of the *Rhotak* branch to *Rhotak*, with all the works necessary thereon:—these works like those of the *Delhi* canal are close on completion. In reference to the two canals, which have one common head, I may here allude to the formation of the masonry dam across the *Súmbe*, now in execution, to supersede the earthen dam there, premising that this dam is swept away annually in the end of June, after which, there is no regular supply of water in the canal, and that it is extending in dimensions. With every exertion, it occupies about 25 days in construction, and as it cannot be commenced before the rains are over, it cannot be completed before the 20th October, and in these 25 days, the fall of the *Jamna* is between two and three feet (exclusive of temporary rises from floods), so that although there is an abundant commencing supply for the season without any work in the *Jamna* on the 1st October,—it is no longer so on the 25th, and it takes 10 days further to stop up the escape channels in the *Jamna* near *Chúharpúr* (which can only be commenced after the bunds below are capable of retaining the water); by this time the river is a foot lower, and the channels at the separation of the eastern and western branches have to be cleared out, which brings the full supply into the canal about the 1st December. With the masonry dam, which may be thrown entirely open down to the level of the bed of the *Súmbe* during the rains*, and which may be planked up to full water level in two days, and sanded in front in three or four; this will be ready for the reception of water on the 1st October, at which period also may be ready a single small intermediate dam, then necessary to bring down water, and the other works may be kept in progress according to the fall of the river, so that the supply, being kept steady from the 1st October, will reach the most distant parts by the 10th, just when wanted, and will not fail, as there will then be leisure to have each necessary work in advance ready at the moment it is wanted; these alone are advantages outweighing a cost beyond what this will be, the temporary work, with all its disadvantages, costing about as much as the interest at four per cent. on the outlay of the permanent one, which supersedes it.

*Restoration of the Doab Canal, East of the Jamna. Main branch,* 135 *miles long; side branches, about* 25 *miles in progress.*

In July 1822, Lieut. DEBUDE of the engineers was appointed by the MARQUIS OF HASTINGS, to survey and report on the then state of the *Doab* canal. The field work of this duty carried on throughout the rains was completed by the end of March, 1823, when Lieut. DEBUDE was relieved by Captain SMITH of the engineers, appointed 31st December, 1822, to complete the surveys and prepare the estimates of expence of restoration of the *Doab* canal, which preliminaries being completed in May, 1823, the work was authorized in December of that year, and commenced on in 1824; and on this canal the great portion of original work of all descriptions being completed before the water was turned in, it was only opened in January, 1830. The general completion of works being immediately followed by the departure of the superintendent, Major SMITH, for Europe, on sick certificate, the duty devolved on his assistant, Lieut. P. T. CAUTLEY, of artillery, under whom the supply of water has been kept up in the face of difficulties, some of which could not be and others were not anticipated. The deranging causes were, first, the great fall in the upper and lower portions of canal combined with looseness of soil; and next, the many mountain-torrents crossing its course. The first, though from end to end† only equal to that of the *Delhi* canal, was disposed of in a much shorter space, and without the strong soil general in the line of the *Delhi* canal

* Practice in the management of the dam, if ultimately completed according to the *original* design, will admit of its being regularly worked in the rains, so as to keep up a constant supply.

† The separation from and junction with the *Jamna* being at points almost on opposite sides of the river.

to counteract its effects. The consequence has been the displacement of the bottom of the canal at its head and tail, where in consequence of the natural inclination of the country, the great portion of the slope was concentrated. The only remedy for such a defect is, a system of lockage ; this has been applied where of most urgent necessity, and for the completion of which a design is now under the consideration of Government, which if sanctioned will do away with the evil. The second cause of disasters, the mountain-torrents which cross its course, (the *Búdhí Jamna,* the *Nyagaön,* and the *Maskarrah raos,* besides smaller ones,) are now I would fain hope nearly, if not entirely, provided for, by the arrangements which last year's operations have completed, and which, there is reason to suppose, are such as are not liable to be injured to any serious extent : but the power of these mountain-torrents is such, as to defy all calculation ;—unseen, their operation in times of flood must almost appear incredible, and in their progress they are so capricious, it is impossible to provide for every contingency, that a series of years may present. These three great torrents have been each provided with extensive masonry dams, laid open during the rains, but capable of being shut up to supply water when required at that season, besides which, the *Maskarrah,* the most dangerous one, has three extensive openings leading into the *Hindan* river, and each now, at least 100 feet in width ; and so much has altogether been done, that, there is no reason to apprehend any further heavy expenditure on this account, except under some operation of nature, which may destroy any portion of the works. These remedial works, and the completion of portions of the original design, which Lieut.-Colonel Smith was unable to finish, have with a few additional, beneficial, or necessary works, been continually in progress since the canal was opened. One of the heaviest labours has been, that of keeping the embankments of sufficient height to prevent the inundation, which would otherwise occur from the deposit of the silt brought down from the upper part of the canal, raising the bottom of the canal wherever the current was sufficiently slack to allow its subsidence; this evil and expence will cease, with its cause above noted.

Having detailed as far as could be done the former and present state of the canals, and the original expenditure, incurred thereon, it remains to notice the purposes for which these canals were reopened, the results to the present period, and the current expenditure for their maintenance in efficiency.

*1st.—Of the purposes for which the Canals were re-opened.*

The original and almost sole purpose of the government in undertaking these works appears to have been to convey a large supply of water from the *Jamna,* for the purposes of irrigation of the crops, 1st, on lines of country where the natural depth of the wells was so great as to render the cost of irrigation from them so heavy as to impede the improvement of the districts, and delay the resettlement of waste villages, as on the *Delhi* canal. 2nd, to supply the means of cheap and easy irrigation to districts, as on the *Doab* canal, where although the wells are not so deep, yet the irrigation from the canal would be so comparatively cheap and easy as to afford the probability of great extension of the benefit: and 3rd, as on FEROZ's canal, to confer the means of irrigation on districts where from the excessive depth of the wells none was heretofore in use, and to convey a supply of good and wholesome water to a country where generally it is brackish or salt; in some districts so much so, as to preclude their occupancy, except for a few months grazing in the rains. To these points alone the general instructions of government tend,—and with such in view, the original estimates of the *Delhi* canal were framed; with the progress of this work, the advantages derivable from water-carriage, brought prominently forward after the water was first turned in, and the means of using the water as a motive power for machinery, of which the late Capt. BLANE, the first superintendent, made a commencement, led to the original designs of the other canals being formed with reference to these ends, which have been followed up on all the canals by further works designed to render one or other of the above purposes more efficient; so that on the completion of the designs either sanctioned or now before government, little further work can be necessary, excepting such as may be for the extension of these various benefits to new parts of the country.

*2nd.—Of the results to the present period.*

The annexed abstracts will show in a condensed form the results up to the end of the last official year. In elucidation of which, and explanation of comparative small returns, with such works, I may possibly be obliged to be more diffuse than I would have wished, to be enabled to convey a correct idea in regard to both the present results shewn by these papers and the future prospects; and first I have to notice, as having general reference to all the canals, the often repeated declaration of the government to the superintendents, as their main rule of guidance, that, the object of government in collecting a rent through them was not so much to form a productive source of revenue from the actual price paid for the water, as to give them an efficient control over its expenditure, by making it of value sufficient to prevent its being wantonly wasted; and that they looked alone to the general improvement of the country, as the source from which they should derive the return adequate to the outlay. This announcement completely prevented the superintendents' disposing of the water so far as irrigation was concerned to the best advantage, and led to the settlement of a fixed rate of assessment so low, that it is not sufficient to prevent carelessness, entailing much waste of water; from which it may be presumed, that, the instructions of government have been fully acted up to, and the rates levied are sufficiently moderate. I am unable to state from want of knowledge whether the improvement of the revenue in canal villages has been commensurate with the expense: I know the rents of many have been raised, and that others, which were reckoned highly assessed, have been by the canal enabled to pay their revenue; and I also know, that tracts of *jangal* have disappeared in many parts, and are superseded by cultivation, supported by the canals. This point might be elucidated on the *Delhi* canal by a statement showing the revenue derived from all canal villages for a series of years before 1820, and for the subsequent years, compared with an account of the revenue derived during the same years from villages not irrigating from the canal, and in which the wells were equally deep. The length of leases being considered,—the advantage I believe would be with the canal villages, and the comparative difference would be fairly attributable to the canals; the improvement which would doubtless appear on the inland villages, as well as a corresponding proportion of that on the canal villages, being attributable to the benefits arising from a settled government superseding an unsettled one. On Feroz's canal a similar comparison might be made, commencing with the year 1826; but the *Doab* canal is too recently opened to afford any room for comparison. I may be permitted here to observe a fact which has forced itself on my notice in my constant intercourse with the inhabitants of canal villages, that, wherever a lease is for any long period of years, of 10 or upwards, or even of five years, improvement, and the use of the canal water make most rapid strides; and that wherever the settlement is too suddenly raised, or is for a short period, or from year to year,—the sole object of the cultivators appears to be to deteriorate their lands, often until they fall into a state from which it is difficult to recover them; and to this the deadly epidemic of 1829-30 has much added, by leaving valuable villages without hands sufficient to cultivate their lands*. The abstracts show that on the *Delhi* canal, an immediate and satisfactory commencement was made by the cultivators, in availing themselves of the benefits put within their reach; on the other canals this is apparently much less the case, the explanation of which appears to me to be simply, that, on the *Delhi* canal and upper parts of FEROZ's canal, irrigation from its waters was merely the resumption of an old practice, of which the memory still remained, and the country being intersected by old water-courses, the villagers had merely to follow up their traces to the canal banks, and clear them out with a tolerable assurance that when opened they would be serviceable, and that their money expended on the clearance would not be thrown away†. On FEROZ's canal, below *Suffídon*, and the *Doab* canal, the case was totally different; no remains of ancient water-courses existed to point out to the inhabitants the mode of drawing the water to their lands; they had not the recollections of such a system of irrigation having existed, and had to buy all their experience of the disadvantages of adopting what was the cheapest mode, a direct cut from the nearest point of the canal to their lands without reference to level; and it was not until they had bought this experience, and failed, that, they would listen to the advice given them, and lead their water-courses so as to answer the purposes. On FEROZ's canal, the system too led to a perfectly new mode of life: instead of continuing a pastoral people, who depended on the periodical rains raising them grain sufficient for their food with little trouble, they early made the discovery, that, with plenty of good water for their cattle, if they used it for irrigation, they must give up a life of idleness for one of comparative labour, and it was only by very slow degrees they acquired the knowledge, that, the advantages derivable from it would compensate them for the labour, and it is only now that the advances are beginning to be rapid, and advice sought as to the best means of availing themselves of the water. It cannot however be expected, that the benefits of the canals in *Hariána* will be developed until the rising generation brought up on the line of canals to labour, forms the majority of the inhabitants; and will not be fully so, until time and good government does away with the recollections of the life of general inactivity, added to the predatory habits, of their forefathers

* This epidemic was not confined to the canals, but extended from *Lúdianah* to *Jaipur*, as also east of the *Jamna*, when the *Doab* canal was not opened. The abstracts will show its effects, from which many places have not yet recovered.

† The expence of clearing out the water-courses, from 100 to 200 rupees per mile, is always incurred by the cultivators, sometimes aided by a loan from government free of interest.

On the *Doab* canal the change is not so great, being only of one system of irrigation for another. It is almost too much in its infancy to allow of comparisons, but the results are consistent with the premises, and the progress of irrigation has been infinitely more rapid than on Feroz's canal, though less so than on the *Delhi* canal; the decrease in the last crop, shown in the abstract, compared with the corresponding one of the preceding year, being solely owing to the excess of rain during the last cold season, diminishing the necessity for water, a cause which has frequently had corresponding results on the *Delhi* canal. It being a clear matter of course that, where rain falls in sufficient quantity to ripen the crops, they will not draw upon the canal for a supply to be paid for.

It was found, chiefly on Feroz's canal, that many villages were inclined to go on as they had heretofore, without employing the water for irrigation, but freely using it for all village purposes, and for the supply of their cattle, saving themselves the expence and trouble of drawing water or maintaining their wells and tanks efficient. As they benefitted considerably by the canal in this way, it appeared reasonable that they should contribute their share to its support; and it was submitted to government, that although villages paying above a certain sum annually (fixed at 100 rupees) in shape of water rent on irrigation, should still have the free use of the water for village purposes, yet that those paying less should contribute to the expences of what they benefitted from, by paying a moderate rate on the number of cattle of all kinds belonging to the village. This rate was fixed at six rupees per 100 head of cattle per annum,—a rate so infinitely below the cost of watering from wells, that, to the westward, cattle are brought to the canal from villages distant many miles. The distinction made in favor of irrigating villages has led to many irrigating up to and beyond the limit, which gives free water to the cattle; and in villages within reach of canal irrigation, this source of income will gradually cease, but will still be continued, and go beyond what it has now attained by the watering of cattle of villages, either so distant, or so situated, as to be unable to irrigate, and it is one so fair and reasonable, that it may safely be continued. The filling of village tanks at certain rates is in fact only a modification of the above, and requires no special notice.

*Of the Employment of the Water for moving Machinery.*

The only application of the water of the canals for the movement of machinery hitherto put in practice has been of a very simple nature, yet producing what will appear comparatively great results, as a source of revenue. The use of the water is let out to those who offer most for it, and as the rent offered can never exceed a rate which must be under the cost of other modes of doing the same work, the employment in this way of surplus water, or of streams again returned to the canal for irrigation, is a general benefit to the community, and tends to cheapen commodities for which the demand is constant.

The first introduction of the system was by Captain BLANE, who permitted the erection of three small mills for grinding flour in *Delhi*, on payment of an annual rent of 25 rupees. Since these, mills of superior powers have been erected at the cost of government, which in *Delhi* and its vicinity are rented at rates varying from two rupees to five rupees per day, each mill; according to its power, which depends on the height of head water available at the different sites. The produce of the flour mills in *Delhi* fluctuates considerably, but with the supply of water now becoming annually more constant, the range will become from 25 to 30,000 rupees per annum, beyond which it is not likely to go. Similar mills are being constructed at *Karnál*, the income from which is expected to realize from 9 to 12,000 rupees,—as the large cantonment, added to the city, will probably yield abundance of work, and time and leisure will enable future superintendents to select many advantageous spots for the erection of small flour mills suited to the demand, every one of which may be more or less a productive source of revenue, compared with the expenditure, if due attention be paid to suit the supply of mills to the probable work. On FEROZ's canal, the only mills erected are those at *Hansí*, less powerful than the *Delhi* ones, but as yet too powerful for the demand; their produce however compared with their expence is satisfactory, and in such a rising town as *Hansí*, full employment for them may be anticipated. With exception of the vicinity of *Jhínd*, no other place holds out work for any extensive sets of mills on this canal, and there the slope of the canal appears sufficient to promise a return of about 15 per cent. on the outlay.

The capabilities of the *Doab* canal in this respect, as in many others, are very great. Flour mills have been erected at *Saharánpúr*, and near *Delhi*, and the produce shown in the abstract is the return from them; others are just completed at *Shamlí* : and there are other large towns capable of affording work for many more, some of which are authorized and others contemplated, the waste water from all being available for irrigation below the mill sites. Besides the above, saw mills are about to be tried at *Delhi* and *Karnál*, places which would yield much of such work, being the marts from which the upper part of western India is supplied with timber, from the forests of the *Jamna* and the Ganges. Models of oil and sugar-cane mills have also been prepared, which promise not only to be successful, but likely to find an abundance of employment, the lines of the *Delhi* and *Doab* canals producing much sugar-cane, with very imperfect modes of expressing the juice.

It will be apparent, that all these modes of employing the water are highly advantageous, and do not interfere with the main purpose of the canals, that of irrigation; the mills being established either where surplus water escapes, or where it is returned below the mills into the canal again, no loss of water is entailed to irrigation, beyond the absorption and evaporation of the mill streams.

*Of the Employment of the Canals for the Transit of Merchandize.*

This object has as yet been only very imperfectly attained, being chiefly limited to the transit of rafts of timber on the line of canals between the forests of the *Jamna*, from which the rafts enter the canal at its head, to all intermediate places, along the canal of Feroz Shah, as far as *Hissar*, a distance of 200 miles. Down the *Delhi* branch from *Rair*, few if any rafts, except for canal works, have passed down, as they could not reach nearer to *Delhi* than 12 miles, from the obstructions presented by the ancient bridges and reduced dimensions of the canal. It is therefore preferable for rafters to use the *Jamna* for such purposes, conveying their rafts to within a mile of the city, though attended often by great danger in the rains, or delays in the hot-weather.

I do not conceive for these reasons, that the *Delhi* branch will ever come into use for rafting, beyond the demand of the vicinity of the canal, which with so much jungle-wood, available for common purposes, is not likely at an early period to be great. The *Doab* canal, it is probable, will be so employed as soon as the completion of the works intended to rectify the disadvantages attendant on the heavy fall at head and tail of this canal, shall afford means of locking the whole line of strong descent. This canal will ultimately come into use for rafting, not only on account of its safety and more equable depth of water, when compared with the *Jamna*, but because *Saharánpúr* is the general mart for all timber brought from the range of hills between the *Jamna* and the Ganges, and the merchants will doubtless see the advantages of at once rafting direct from *Saharánpúr* to *Delhi* by a safe and expeditious line of water carriage, instead of incurring the cost of a land carriage of 16 miles to the *Jamna*, added to the danger and delays of the river navigation.

In regard to boat navigation, all that has yet effected has been done by the superintendent, in using boats for the transport of lime, from the upper to the lower parts of the canal, which has been a matter of great convenience, from the difficulty of procuring land carriage; indeed more so than one of saving, on account of the unformed condition of the canal banks for the purpose of track-age. In this respect, the *Doab* canal is well advanced; to make its banks available, nothing beyond a clearance of trees is necessary, when it may become an object to cut them down, on completion of the locks. On the *Delhi* and *Hariána* branches, the necessary work is rapidly progressing, and the last lock necessary is just completed. To establish such a novelty however will, I fear, require the experiment, to be made by the government, of establishing some boats suited to the canals, to ply for the carriage of goods; for instance, between *Karnál*, or *Rair* and *Hansí*, and I think such might shortly be done with advantage. There is at present a most extensive traffic existing across from the *Doáb*, through *Pánípat*, and *Sonípat* to *Hansí*, for the export of sugar; the return being salt, and coarse grain, and *Hansí* being one of the chief entrepôts in that quarter, for the supply of the western states. It appears to me, it would conduce greatly to the prosperity of *Hansí*, if the line of trade could be diverted from *Pánípat* to the canal at *Rair*, where the *Hansí* and *Delhi* branches separate, instead of proceeding direct from *Pánípat* to *Hansí* viâ *Neaulta*, by a land carriage of about 70 miles. From *Rair*, the sugar loaded on the canal boats could either proceed to within 12 miles of *Delhi**, saving about 40 miles of land carriage, or by FEROZ's canal to *Hansí*; on this latter line a return cargo would always be secure; and north of *Karnál*, being a great sugar country, it is probable much would be exported thence, independent of that reaching the canal from the *Doáb*, by *Pánípat*. Another mode in which it is probable such a trade might be established would be the offer of a premium, to the individual who should have conveyed the greatest value of imports and exports by the canal, beyond some fixed sum, up to a stated period. Some mode which would give the merchants a knowledge of the advantages to be derived from water over land carriage, without entailing on them present expence and risk, will I think be necessary, to set the matter going, after which it may be safely left to its own merits.

Of rafting on FEROZ's canal, the knowledge of relative cost and charges was first given, by all timbers for the canal and garrison works at *Hansí* being rafted by the canal; and the result has been, that, the

* At the cost of a single draw-bridge, boats could be enabled to reach within six miles of *Delhi*, and alterations to three old bridges would take them to within two miles of *Delhi*.

import of timber from *Karnál* to *Jhínd, Hansí,* and *Hissar,* by land carriage, has been completely superseded, the canal being capable of carrying rafts, of the heaviest timbers, including all charges and the canal duty, at a cost of about one-half of the land carriage; and corresponding results may be expected elsewhere, when once the advantages of transport of merchandize by boats is clearly shown. The boats suitable to the canals should be long and narrow, and of burthen from 100 to 200 maunds*, sharp at both ends, and with a falling mast, and sail, to take advantage of the wind so often favorable for a return passage against the stream. The current however is no where sufficient to offer any serious impediment to tracking up.

*Of sundry minor Items of Revenue.*

With the view of preventing waste, and discontent, or complaints of partiality, it has been made a rule on the canals, that, nothing, the produce of the canals, shall be given free of payment of what is deemed an equivalent, and that whoever chooses to give the equivalent may have the right purchased. This leads to sundry small collections, which individually trifling are collectively sufficient to pay a most considerable portion of the outlay in improving this source of income, by planting timber trees on the canals. In the rains, the canal bounds produce annually a strong growth of various descriptions of grasses, and jungle; these have to be cleared annually to admit of repairs and access to the banks; what is unprofitable is burnt, and what is useful is stacked and sold. The bounds are in many parts covered with trees of natural growth, of which such as would impede the ultimate purpose of trackage are disposed of when wanted in the neighbourhood. Licences are also granted for cutting forage from the canal bounds. These together produce the sums stated in the column of "sale of produce of canal bounds," in the annexed abstracts, which though as yet trifling will ultimately become of material amount, when the useful forest timber trees, now planting on the canals, shall attain value with age, of which an idea may be formed from the canal banks, west of the *Jamna,* affording space for about 200,000 trees to attain maturity; they are planted in such numbers that from 10 to 15,000 get past the age of danger annually, at an expenditure limited to 2000 rupees. At the age of 20 years, the average value of each timber, if only rated at $2\frac{1}{2}$ rupees, would admit

* 1 to 200 maunds of sugar, grain, and such heavy articles would lie inside a boat of three feet depth, of suitable length, and 7 to 8 feet beam, which might be safely loaded to draw two feet water, so as to pass under the bridges freely at common water level.

a similar number to be cut down annually, being in value, at the above average, 30,000 rupees; though when once the regular cutting commences, it will of course only be picked trees which are felled in number suited to the demand for public and private purposes, and which individually will be far more valuable. The produce of the canal bounds may therefore I think be ultimately of considerable importance, and probably much more than I anticipate, from the destruction of the natural forests of the country from want of protection*, and the total absence of any system of plantation in this part of the country.

The only other item of income noticeable as having been one anticipated by Captain Blane is that, from renting out the fishing of the canal; as yet it is hardly worth notice, and can never be of any moment, if I may judge from past experience.

As a source of revenue fines should not properly be estimated : the object of levying them is to aid in the prevention of waste or wilful misuse of the canal waters ;—to protect the embankment from injury, and thereby save its vicinity from inundation :—and to secure the plantations from depredation and negligence.

Note.—The above report concludes with accurate statements of the various items of expence incurred upon the canals, for which we cannot find space; we have however endeavoured to condense their contents into the following table, under such heads as could be readily separated.—Ed.

*Abstract of Expences incurred, or estimated, upon Permanent Works of the three Canals, up to the present time.*

| Denomination of work. | Delhi Canal. | | | Hariána Canal. | | | Doab Canal. | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rs. | A. | P. | Rs. | A. | P. | Rs. | A. | P. |
| Excavations and embankments, | 1,60,309 | 2 | 10 | 3,50,653 | 3 | 4 | 1,76,426 | 8 | 0 |
| Overfalls, escape dams, weirs, regulators, and sluices, ....... | 1,03,113 | 8 | 9 | 26,769 | 3 | 2 | 1,20,656 | 14 | 1 |
| Bridges (some with locks), .... | 1,02,547 | 10 | 9 | 69,658 | 15 | 9 | 95,315 | 2 | 3 |
| Under ground channels, ...... | 3,099 | 1 | 9 | 6,500 | 0 | 0 | .... | | |
| Irrigation outlets, &c. ........ | 4,500 | 0 | 0 | 35,769 | 14 | 0 | 36,234 | 11 | 2 |
| Experimental works,......... | 4,938 | 14 | 0 | .... | | | .... | | |
| Water-mills for saws, flour, &c... | 45,538 | 10 | 8 | 6,351 | 9 | 4 | 25,192 | 14 | 0 |
| Depôts, choukís, &c.......... | 4,414 | 6 | 0 | .... | | | 8,195 | 0 | 9 |
| Plantations of trees on banks,.. | 2,281 | 15 | 1 | 2,283 | 15 | 3 | 5,490 | 13 | 4 |
| Establishment, .............. | 52,264 | 9 | 11 | 52,175 | 8 | 4 | .... | | |
| Total of Estimates and Bill for Works,.......... | 4,83,007 | 15 | 9 | 5,50,162 | 5 | 2 | 4,67,511 | 15 | 7 |

* The forests of the *Jamna* are nearly destroyed from indiscriminate cutting, since they fell under our authority: any one is allowed to cut what he pleases, and where he pleases, on payment of a merely nominal duty, and the whole country resorts here for supplies. Formerly it was not so: the result is, that now there is not a saul tree fit for public purposes, within six miles of the river; no roads exist, and the cost of timber in consequence in my recollection has doubled.

The total first outlay for the restoration of the system of canals will by this table appear to have been about fifteen lakhs of rupees :—it is impossible on the present occasion to specify the particulars of the various works of engineering skill which the nature of these canals rendered necessary :—one of the sluice dams was described in our number for Oct. 1832 (vol. i. p. 454), and we hope hereafter to select for insertion other works equally novel and interesting to Engineers, from among the numerous plans and designs transmitted by the Superintendent to Calcutta. Meanwhile, we must conclude this notice with a condensed abstract of the revenue of the canals, and the ordinary outlay in maintaining them, also compiled from Major Colvin's statements.

*Abstract of the Revenues and ordinary Expences of the several Canals since the period of their restoration.*

REVENUE.

| From what source. | Delhi Canal, for 23 half years, up to 1830—31. | | | Hansí or Feroz's Canal, 11 half years, up to 1830—31. | | | Canals west of the Jamna, since the accounts were united for one year, 1831—32. | | | Doab Canal, for 4 half years, up to 1831—32. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rs. | A. | P. | Rs. | A. | P. | Rs. | A. | P. | Rs. | A. | P. |
| Rent of ground under irrigation, *Rabi* crop, | 1,88,070 | 5 | 5 | 38,185 | 10 | 6 | 27,698 | 3 | 4 | 9,559 | 12 | 0 |
| ,, *Kharif* ditto,.. | 1,47,522 | 4 | 1 | 30,012 | 1 | 3 | 23,318 | 1 | 7 | 4,074 | 11 | 10 |
| Rent for watering cattle, | 2,098 | 5 | 7 | 8,334 | 13 | 10 | 4,210 | 9 | 7 | .... | | |
| Rent of water-mills, .. | 80,029 | 14 | 5 | 8,332 | 13 | 9 | 19,002 | 3 | 7 | 3,361 | 6 | 8 |
| Transit duty on rafts of timber, ............. | 2,933 | 4 | 0 | 3,957 | 3 | 7 | 2,061 | 15 | 0 | .... | | |
| Sale of produce of canal bounds, ............ | 4,299 | 14 | 9 | 1,469 | 13 | 10 | 1,810 | 6 | 11 | 1,271 | 11 | 9 |
| Sundries—fishing, filling tanks, &c........... | 2,250 | 15 | 4 | 1,547 | 11 | 11 | 317 | 0 | 1 | .... | | |
| Fines for breach of canal regulations, ........ | 15,711 | 5 | 9 | 8,047 | 11 | 7 | 2,463 | 2 | 10 | 1,985 | 10 | 0 |
| Total income,.... | 4,42,916 | 5 | 4 | 99,888 | 0 | 3 | 80,881 | 10 | 11 | 20,253 | 4 | 3 |
| Annual income, say, .. | 42,000 | 0 | 0 | 20,000 | 0 | 0 | 81,000 | 0 | 0 | 10,000 | 0 | 0 |

EXPENDITURE.

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Establishment for superintendence of works, collections, &c................ | 3,47,195 | 7 | 9 | 1,51,770 | 10 | 0 | 79,722 | 14 | 7 | 74,715 | 6 | 2 |
| Amount of the ordinary repairs, as per monthly bills, ...... | 69,169 | 12 | 4 | 5,803 | 6 | 6 | 18,342 | 8 | 5 | 10,509 | 5 | 6 |
| Total expenditure, | 4,16,365 | 4 | 1 | 1,57,574 | 0 | 6 | 98,065 | 7 | 0 | 85,224 | 11 | 8 |
| Annual expense, say,.... | 40,000 | 0 | 0 | 28,000 | 0 | 0 | 98,000 | 0 | 0 | 42,500 | 0 | 0 |

II.—*Abstract of Observations of the Temperature, Pressure, and Hygrometrical state of the Air at Nasírábád. By* Major T. Oliver.

The barometer is the same I used at Delhi, and the observations have been reduced by the same quantity (.055), to make them comparable with those in the Surveyor General's office. The thermometers are also the same. I have not been able to note the barometer at 10 A. M. excepting for two or three months: the daily range appears to be about 0.10. The mean temperature of the day has throughout been taken as the mean of sunrise and 2 h. 30 m. P. M.; and of the night, the mean of sunset and sunrise. I lately obtained from Calcutta one of Daniell's hygrometers, intending to compare its dew-point indications with the wet thermometer depressions in this dry climate; but I cannot procure ether that will produce a depression of more than 5° or 6° below what water will effect, and this of course is useless here, unless in the rains. We have already a sufficient number of comparisons of this sort in moist air, but it would be desirable to have them in the dry air of this part of the country. As the moist thermometer sinks sometimes as much as 40°, some freezing mixture must be requisite to get the dew-point in such cases, where I imagine the best ether would not answer the purpose.

Regarding the Tables I now send, it will be observed, that in Table III, I confine myself merely to temperatures and wet thermometer depressions: these can be reduced at any time into tensions, when the subject may have undergone due investigation: in the mean time, the dew points and mean comparative tensions have been calculated, as in my former communication.

Table I.—*Barometer reduced to 32°; Temperature of the external Air and Deduced Elevation of Nasírábád above Calcutta.*

| Year and Month. | Barom. 4 P. M. | Temp. of Air. | Elevation. | Year and Month. | Barom. 4 P. M. | Temp. of Air. | Elevation. |
|---|---|---|---|---|---|---|---|
| | In. | ° | Feet. | | In. | ° | Feet. |
| Dec. 1830, .. | 28,513 | 72,8 | 1435 | Dec. 1831, .. | 28,467 | 65,2 | 1462 |
| Jan. 1831, .. | ,510 | 72,2 | 1468 | Jan. 1832, .. | ,483 | 68,8 | 1430 |
| February, .. | ,398 | 68,4 | 1474 | February, .. | ,365 | 69,6 | 1488 |
| March, .. .. | ,338 | 85,1 | 1529 | March, .... | ,312 | 79,7 | 1493 |
| April, ...... | ,230 | 95,3 | 1508 | April, ...... | ,218 | 95,9 | 1526 |
| May, .. .... | ,117 | 102,7 | 1495 | May, ...... | ,161 | 98,2 | 1497 |
| June, .. .... | 27,979 | 99,4 | 1532 | June, ...... | 28,000 | 100,1 | 1526 |
| July, .. .. .. | 28,003 | 94,5 | 1529 | July, ...... | 27,951 | 91,4 | 1539 |
| August, .. .. | ,040 | 87,2 | 1500 | August, .... | 28,032 | 85,8 | 1425 |
| September, .. | ,138 | 85,9 | 1493 | September, .. | ,183 | 88,3 | 1504 |
| October, .... | ,278 | 87,6 | 1444 | October, .... | ,340 | 89,2 | 1466 |
| November, .. | ,407 | 76,1 | 1431 | November, .. | ,461 | 81,3 | 1473 |
| Means, .. .. | 28,246 | 85,6 | 1487 | Means, .. .. | 28,248 | 84,5 | 1486 |

TABLE II.—*Mean Temperature of each Month, with the differences from the Mean of the Year.*

| Month. | Day. | Diff. from Mean. | Night. | Diff. from Mean. | Sunset. | Diff. from Mean. |
|---|---|---|---|---|---|---|
| | o | o | o | o | o | o |
| January, ........ | 60,3 | — 16,3 | 57,2 | — 16,0 | 65,4 | — 14,2 |
| February, .. .. .. | 60,0 | — 16,6 | 57,6 | — 15,6 | 64,5 | — 15,1 |
| March, .. .. .... | 71,7 | — 4,9 | 69,0 | — 4,2 | 77,9 | — 1,7 |
| April, .......... | 86,0 | + 9,4 | 82,0 | + 8,8 | 90,0 | + 10,4 |
| May, .... .... .. | 90,5 | + 13,9 | 86,5 | + 13,3 | 93,6 | + 14,0 |
| June, .......... | 91,6 | + 15,0 | 86,7 | + 13,5 | 91,3 | + 11,7 |
| July, ...... .... | 86,7 | + 10,1 | 83,0 | + 9,8 | 86,7 | + 7,1 |
| August, .... .... | 82,1 | + 5,5 | 79,0 | + 5,8 | 81,7 | + 2,1 |
| September, .. ... | 81,4 | + 4,8 | 78,7 | + 5,5 | 83,0 | + 3,4 |
| October, ........ | 79,3 | + 2,7 | 75,6 | + 2,4 | 83,1 | + 3,5 |
| November, ...... | 68,7 | — 7,9 | 65,0 | — 8,2 | 73,3 | — 6,3 |
| December, ...... | 60,6 | — 16,0 | 57,7 | — 15,5 | 64,3 | — 15,3 |
| Means, .... .... | 76,6 | | 73,2 | | 79,6 | |

TABLE III.—*Temperature of the Air and Depression (D) of Wet Thermometer.*

| Year and Month. | Sunrise. | | 2h. 30m. P. M. | | 4 P. M. | | Sunset. | |
|---|---|---|---|---|---|---|---|---|
| | Temp. | D. | Temp. | D. | Temp. | D. | Temp. | D. |
| | o | o | o | o | o | o | o | o |
| December, 1830, . | 49,8 | 9,5 | 73,7 | 19,1 | 72,8 | 18,8 | 67,3 | 16,2 |
| January, 1831, .. | 50,3 | 9,6 | 72,9 | 17,8 | 72,2 | 17,7 | 68,2 | 16,4 |
| February, ...... | 50,0 | 5,5 | 68,9 | 13,9 | 68,4 | 14,0 | 65,1 | 12,2 |
| March, ........ | 62,5 | 10,1 | 85,3 | 22,2 | 85,1 | 22,1 | 81,8 | 19,1 |
| April, .......... | 74,4 | 14,7 | 97,8 | 29,4 | 95,3 | 28,0 | 90,0 | 25,0 |
| May, .......... | 82,5 | 16,7 | 104,6 | 33,6 | 102,7 | 32,9 | 95,7 | 26,7 |
| June, .......... | 82,7 | 9,1 | 100,3 | 22,9 | 99,4 | 23,1 | 89,2 | 14,5 |
| July, .......... | 78,8 | 5,1 | 95,5 | 17,5 | 94,5 | 17,0 | 86,9 | 10,8 |
| August. ........ | 77,1 | 2,7 | 88,6 | 10,2 | 87,2 | 9,6 | 82,1 | 5,7 |
| September, ...... | 76,2 | 3,7 | 87,4 | 15,1 | 85,9 | 10,9 | 82,6 | 7,9 |
| October, ........ | 69,1 | 8,5 | 89,4 | 22,1 | 87,6 | 20,7 | 82,6 | 14,9 |
| November, ...... | 55,3 | 7,0 | 77,4 | 18,3 | 76,1 | 17,9 | 70,0 | 14,3 |
| Means, 1st Year,.. | 67,4 | 8,5 | 86,8 | 20,2 | 85,6 | 19,4 | 80,2 | 15,3 |
| Dec. 1831, ...... | 52,6 | 3,9 | 66,2 | 9,3 | 65,2 | 9,0 | 61,2 | 7,6 |
| Jan. 1832, ...... | 47,9 | 5,9 | 70,2 | 16,2 | 68,8 | 15,8 | 62,6 | 12,5 |
| February,.. .... | 51,1 | 7,0 | 70,4 | 16,6 | 69,6 | 16,7 | 64,0 | 13,3 |
| March,.......... | 57,6 | 10,4 | 81,2 | 22,7 | 79,7 | 22,2 | 74,0 | 18,3 |
| April, .......... | 73,7 | 16,0 | 97,3 | 32,5 | 95,9 | 31,3 | 89,9 | 25,2 |
| May, .......... | 76,0 | 14,6 | 99,0 | 32,5 | 98,2 | 32,3 | 91,6 | 27,8 |
| June, .......... | 81,3 | 10,4 | 101,6 | 26,7 | 100,1 | 26.2 | 93,3 | 21,3 |
| July, .......... | 79,5 | 5,5 | 93,4 | 16,1 | 91,4 | 14,9 | 86,6 | 11,2 |
| August, ........ | 75,6 | 3,2 | 87,0 | 10,8 | 85,8 | 10,0 | 81,2 | 7,0 |
| September, ...... | 72,7 | 6,3 | 89,5 | 17,9 | 88,3 | 17,5 | 83,3 | 14,5 |
| October, ........ | 67,4 | 13,5 | 91,5 | 28,9 | 89,2 | 27,6 | 83,6 | 24,2 |
| November, ...... | 59,3 | 10,5 | 83,8 | 22,8 | 81,3 | 21,5 | 76,6 | 18,5 |
| Means, 2nd Year, | 66,2 | 8,9 | 85,9 | 21,1 | 84,5 | 20,4 | 79,0 | 16,8 |

TABLE IV.—*Dew point (S), calculated from the Depression in Table* III. *Comparative Tension (T), and Grains of Aqueous Vapour in a cubic foot of Air (G.)*

| Year and Month. | S. | T. | G. | Year and Month. | S. | T. | G. |
|---|---|---|---|---|---|---|---|
| | o | | | | o | | |
| Dec. 1830, .. | 31,8 | ,338 | 2,37 | Dec. 1831, .. | 48,6 | ,683 | 4,26 |
| Jan. 1831, .. | 34,0 | ,370 | 2,57 | Jan. 1832, .. | 36,9 | ,445 | 2,84 |
| February, .. | 41,6 | ,528 | 3,33 | February, .. | 36,5 | ,418 | 2,80 |
| March,...... | 45,5 | ,372 | 3,74 | March, .... | 35,5 | ,299 | 2,66 |
| April, ...... | 46,2 | ,260 | 3,75 | April, ...... | 38,6 | ,196 | 2,84 |
| May, ...... | 48,9 | ,224 | 4,03 | May, ...... | 40,4 | ,201 | 3,00 |
| June, ...... | 67,9 | ,463 | 7,53 | June, ...... | 61,9 | ,379 | 6,20 |
| July, ...... | 71,6 | ,606 | 8,56 | July, ...... | 71,4 | ,617 | 8,52 |
| August, .... | 74,4 | ,759 | 9,45 | August, .... | 72,0 | ,738 | 8,77 |
| September, .. | 70,0 | ,685 | 8,21 | September, .. | 62,4 | ,533 | 6,43 |
| October, .... | 55,4 | ,449 | 5,17 | October, .... | 35,6 | ,215 | 2,62 |
| November, .. | 43,0 | ,438 | 3,47 | November, .. | 40,2 | ,336 | 3,07 |
| Means,...... | 52,5 | ,458 | 5,02 | Means, .. .. | 48,3 | ,422 | 4,50 |

III.—*Determination of the Constant of Expansion of the standard* 10-*feet Iron Bar of the great Trigonometrical Survey of India; and expansions of Gold, Silver and Copper by the same Apparatus. By* Jas. Prinsep, F.R.S. *Sec.*

When I submitted the results of my former experiments on the expansion of iron, brass, and lead, which were printed in the GLEANINGS IN SCIENCE for December, 1831, I ventured to anticipate that the simplicity of the process then contrived for heating the metals would be a recommendation for its adoption in any future researches of a similar nature. The opportunity has not been long wanting; and as it has involved the necessity of a more scrupulous degree of accuracy, from the important purpose to which the results were to be applied, I feel it incumbent upon me to enter into fuller detail in describing the course of experiment pursued. The gigantic scale of the former trials, with bars of twenty-five feet in length, was calculated to obviate most of the errors of observation, as well as any want of extreme delicacy in the measuring apparatus; but on the present occasion, although the bars were of smaller dimensions, the other concomitants were much more satisfactory; and I may confidently maintain that, with the present and the former series, we now possess a more correct table of the dilatations of gold, silver, iron, copper, brass, and lead, than have been hitherto published in works of natural philosophy.

It will be remembered, that the measurement of the base for the great Trigonometrical Survey of India, on the Barrackpúr Road, was conducted with compensation bars of a peculiar construction, each of them ten feet in length, or, bearing near their extremities two minute points, intended to represent that distance without liability to alter by change of temperature. Their construction has been accurately described by Major Everest in the 18th volume of the Asiatic Researches. To prevent the possibility of derangement in all or any of these compound bars; and to serve as a term of comparison for the whole, a standard iron bar was furnished along with them from England, upon which was laid off *at a certain temperature* with all imaginable accuracy, the measure of the English parliamentary standard, to which all the measures of the Indian meridian line should be thus reducible.

After the completion of the Barrackpúr base, the compensation bars underwent a most rigid comparison with THE STANDARD; as did also the steel chains used in measuring the several bases of Col. Lambton's Survey in the peninsula. The particulars of these comparisons, conducted with that most elaborate care and precaution, which has distinguished all the operations of the new survey, will be described by Major Everest himself, when he shall favour the public with the result of his labours. At present it is but one item of these precautionary measures which will come under our review.

The comparisons with the standard bar were made at a temperature differing by many degrees from that at which the latter had been proved in England. It became therefore necessary to apply a correction for its dilatation by heat: but to do this a question naturally arose as to what *constant* should be employed? The expressions given by different experimenters vary from 1.00144 (Troughton) to 1.00118 (Dulong et Petit), or one-sixth of the whole quantity,—a variation either to be attributed to imperfections in the mode of experimenting, or to difference of quality in the metal,—but in either way rendering it advisable to have recourse to a new set of experiments, to obtain the individual expansion of the standard bar itself. The experiments made by myself in Dec. 1831 upon a rod of iron twenty-five feet in length, though nearly agreeing with the results of Lavoisier and Smeaton*, were for the same reason inapplicable to a metal which might be of different quality. It was therefore determined by Major

| | | |
|---|---|---|
| * Expansion of wire-drawn iron by | Lavoisier, ................ | 1.001235 |
| | Smeaton, ................ | 1.001258 |
| | Prinsep, ...... .......... | 1.001256 |

Everest to submit the bar to a new inquiry, attended with every precaution to insure confidence.

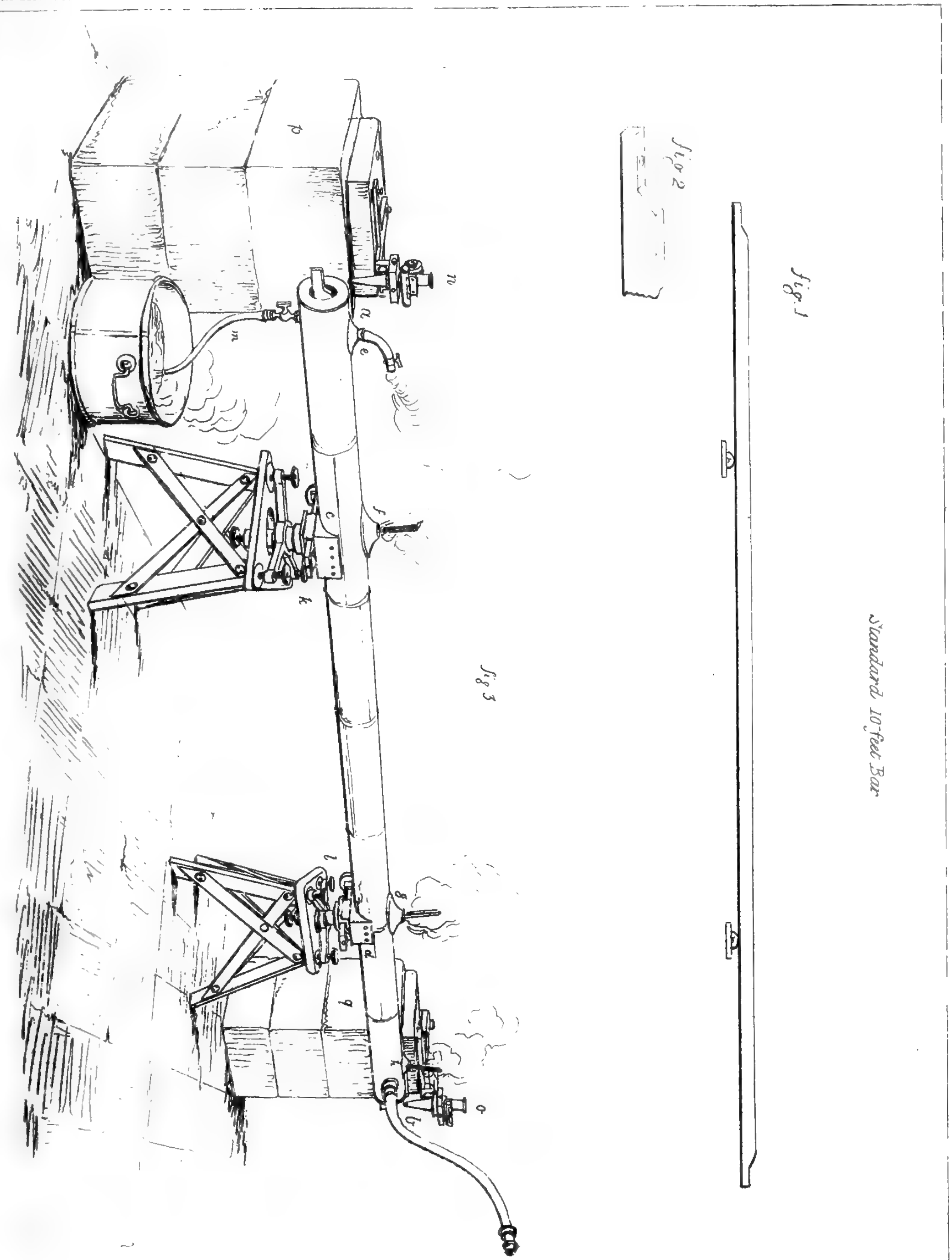
The process adopted was framed on the principle pursued on the former occasion, namely the employment of a steam-pipe, to heat the metal uniformly to the boiling point. The section of the bar, $2\frac{1}{2}$ inches by $\frac{3}{4}$, prevented its application in the same simple manner, by insertion in a leaden pipe; and it was determined to employ micrometers on the microscope principle of Troughton to read off the expansions;—a new apparatus was therefore constructed by Mr. H. Barrow, H. C. Mathematical Instrument-maker, of which the following description, with reference to the perspective view in Plate VII. will explain the nature.

A double cylindrical case *a b* (fig. 3) was made, 9 feet 11 inches in length, and four inches in outside diameter, the inner cylinder being of copper, the outer case of tin. The space between them was shut in at the two ends, with perforated discs, so as to allow the bar to be inserted freely into the inner tube. The bar was supported in the tube upon two brass rollers, enclosed in the steam-tight square boxes at *c, d*, and situated at the same distance apart as the rollers upon which the bar is always supported in its own wooden case. (fig. 1.)

The tubes were pierced through from above in four points *e, f, g, h*, for the introduction of thermometers, the bulbs of two of which (*f, g*,) penetrated into deep cavities apparently provided for the purpose in the bar itself; these were filled with mercury, to insure the right reading of the temperature of the bar. The cylinder, *a b*, was supported on two of the brass tripods of the measuring apparatus, technically called *camels, k, l*, which are provided with vertical and horizontal screw motions to adjust the position of the bar. The steam was admitted from my small engine by a pipe at the northern extremity *b*, and suffered to escape freely from the waste pipe *m* at the other end.

Two micrometer-microscopes, *n, o*, were firmly attached by screws to two isolated solid blocks of stone, *p, q*, built upon the stone pavement of the laboratory at the requisite distance apart; the focus of the object glasses being adjusted in true verticals to distinct vision of the minute dots on the silver discs of the standard bar, when the latter was itself adjusted horizontally to a perfect level by means of a theodolite placed on the opposite side of the room.

The object of the double cylinder, according to the original design, was, to encompass the bar with a steam jacket, and thus heat it to the requisite point without allowing the steam itself to come in contact with, and thus to corrode, the iron; as well as to prevent its escape from the two open ends, which would incommode the glasses of the microscopes:




Apparatus for measuring the expansion of Metals.

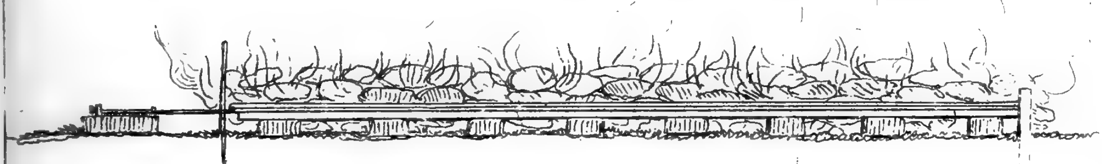


fig 4

James Prinsep del. Mode of annealing the gold and Silver bars JP. sculp

it was found however at the onset that the heating of the bar in dry air, although surrounded closely by the copper tube, was a most tedious process, whereas it was effected immediately by contact with the steam, which, condensing on the colder surface of the metal, delivered its latent heat, and did not issue from the vent until the whole apparatus had been effectually brought to the boiling point. It was therefore a fortunate circumstance that a leak in the inner tube, in the course of the first experiment, threw open a communication for the steam to the inner chamber: this was afterwards enlarged by piercing a hole through the copper, immediately in front of the steam injection pipe *b*. The only inconvenience produced therefrom was, that a little steam escaped from the two ends where the bar necessarily projected under the microscopes. This was however obviated by packing with cotton, and screening the object glasses with paper. The steam issued in plentiful clouds from the thermometer apertures *f* and *g*.

Having thus described the apparatus as it stood during the experiments, I must be allowed to add a few words on the capabilities of the several parts of it: and *first*, of the micrometers. The northern microscope was immovable, bearing fine cross wires in its field, to which the centre of the corresponding dot on the bar was brought by the lateral screw of the camel K. The cross wires of the southern microscope on the contrary had a range of about a tenth of an inch, which it subdivided by 20 revolutions of the centesimally-divided screw-head into 2000 parts. The micrometer was therefore sensible to the 20000th part of an inch, or more rigidly, each division of the index was equal to $\frac{1}{26270}$ inch, and the error of reading did not amount on several trials to more than one or two such divisions.

*Secondly*. Of the thermometers. There was some difficulty in procuring good instruments with naked bulbs, and it was necessary to remove common ones from their metal scales to adapt them to the apparatus, and to scratch the degrees on the tubes; many thermometers were broken from this and other causes. As the precaution was taken of comparing their boiling points, and their indications at the general temperature of the air, with a standard instrument, no error on this score was to be feared beyond the necessary difficulty of reading off to fractions of a degree, where the instruments were only divided to every two degrees. The *mean* thermometric error cannot however be estimated at more than 0.2 of a degree, which upon a range of 140 degrees will not affect the resulting dilatation more than $\frac{2}{1400}$ths, or about 2 in the sixth place of decimals. The fact is that the bar itself was a much more delicate measurer of the mean heat of the apparatus than the thermometers.

The error of the readings therefore upon a length of 10 feet (assuming it even to a $2\frac{1}{2}$ divisions of the micrometer) will not surpass 0.000001, while the error of the thermometer reading may amount to 0.000002: it will be seen from the tables which follow, that the general run of the experiments fully confirms this estimate of accuracy; at the same time it would be useless to carry the expression of the dilatation beyond the sixth decimal, as is frequently done in cases less entitled to reliance.

The order of each experiment was similar to that described in my former paper. When several readings had been made at the temperature of the room, the steam was let on and kept up for several hours, during which the second readings were made. Cold water was not introduced, as it took a long time to restore an equal temperature, and it was found better to allow the apparatus to cool down gradually by the following morning.

It was only in the third series of experiments that the bar remained quite stationary at the higher temperature for more than two hours. In general it was remarked that the reading of the micrometers gave the metal a maximum dilatation at the first moment of its being brought to the boiling point, gradually falling off even to the extent of 20 divisions ($\frac{1}{1000}$th of an inch), as the steaming continued. This was evidently not attributable to change of temperature in the steam, for the thermometers were not affected. I imagined that it must be produced by torsion or curvature of the bar, from the under part of it being at first less heated than the upper; for, by the construction of the apparatus for steaming, it is evident that, on the introduction of the steam, the upper parts of the tube would become heated first, while the condensed steam collected in the lower part of the cylinder imparted a lower temperature to the under surface of the bar: but this would cause the bar to assume a slight curvature upwards, which, as the supporting rollers were situated in distance one-fourth from the ends, would tend to depress the dots below the true focus of the microscope; the effect of this and of the curvature would be to make the bar *shorter* than otherwise, so that this explanation cannot be admitted.

Some very curious experiments, however, which are described by Captain Kater in the Phil. Trans. for 1830, may serve to afford an explanation of the anomaly. That gentleman found that the error in the linear measurement of a flat bar of 36 inches in length, might amount to .001 inch, simply by its resting upon an uneven surface, and assuming a curvature therefrom, the versed sine of which amounted to no more than .01 inch; now the difference between the chord and the arc is this case, is less than a hundred thousandth of an inch, and is, therefore, inappreciable; nor is it attempted to explain in what way the effect observed should be one hundred times greater than could have been expected. Captain Kater, it is true, immediately devised a remedy for this anomaly, by seeking the neutral axis of the bar, and imprinting the dots upon ledges formed at the two extremities in this plane. The Indian standard bar was formed on this principle, the parts bearing the dots being two-fifths in vertical height of the remainder of the bar (figs. 1, 2.): but upon a length of 10 feet, we may conceive that a trivial error in the assumed position of this neutral axis may be sufficient to account for the slight anomaly in the readings alluded to. It will be evident that on the slightest slackening in the supply of steam, the upper part of the bar would become cooler than the lower, for the same reason as given above, and a contrary flexure would thus take place to a similar amount. By taking therefore the mean reading of each series of experiments, we need not fear any influential error from this source, which I have the rather pointed out on account of its apparent confirmation of Captain Kater's curious discovery.

We will now proceed to the experiments, placing them in a tabular form according to their dates, and correcting the thermometers, &c. to a common standard.

*First Series, 20th November, Standard Iron Bar A.*

| Number of Observations. | Thermometers. | | | Hour of Observation. | Micrometer Readings. | Observations. |
|---|---|---|---|---|---|---|
| | In the steam-pipe. | Inserted in the Bar. | | | | |
| | | North end. | South end. | | Divisions. | |
| | | ° | ° | | | |
| 1 | | 75,3 | 77,2 ? | Noon | —1067 | The indications of the micrometers and thermometers were read off simultaneously at equal intervals of time, to ascertain the ratio of calorific accession, but the opening of a leak prevented the completion of the series. Observers, Major Everest and Captain Wilcox. |
| 2 | | 152, | 152,0 | | — 82 | |
| 3 | | 170,8 | 164,7 | | + 113 | |
| 4 | | 178,6 | 169,7 | to | + 211 | |
| 5 | | 184,4 | 185,4 | | + 314 | |
| 6 | | 190,2 | 194,0 | | + 493 | |
| 7 | | 212,0 | 212,0 | 4 P. M. | +1157 | |
| 8 | | 212,0 | broken | | +1151 | |
| 9 | 210,6 | 212,0 | | | +1140 | |
| 10 | 210,2 | 212,6 | | | +1133 | |
| 11 | 213,3 | 212,8 | | | +1152 | |
| 12 | | 201,2 | | | +1033 | |
| 13 | | 188,9 | | | + 806 | |
| Difference of temperature, | | 136,0 | | dilatation, | 2213 | |

*Second Series, 21st November 1832. Standard 10 feet Bar.*

| Number of Observations. | Thermometers. In the steam-pipe. | Inserted in the Bar. North end. | South end. | Hour of Reading. | Micrometer Readings. Divisions. | Observations. |
|---|---|---|---|---|---|---|
| | o | o | o | H. M. | | |
| 1 | 80,1 | 77,9 | 78,0 | | —1050 | Focal distance of mi- |
| 2 | 79,9 | 77,6 | 77,5 | 3 49 P.M. | —1071 | crometer 2,15 inches; |
| 3 | 214,2 | 212,5 | 212,0 | | +1127 | barometer 29,97 inches; |
| 4 | 214,2 | 212,6 | 212,0 | | +1116 | stopcock of steam-pipe |
| 5 | 217,2 | 212,4 | 212,0 | | +1099 | frequently opened and |
| 6 | 215,4 | 212,8 | 212,5 | | +1114 | closed during this se- |
| 7 | 212,6 | 208,2 | 211,6 | | +1083 | ries. |
| 8 | 215,1 | 211,4 | 211,9 | | +1089 | Readings by Major |
| 9 | 214,8 | 212,3 | 212,4 | | +1101 | Everest and Capt. Wil- |
| 10 | 214,4 | 212,5 | 212,1 | 5 0 P. M. | +1106 | cox. |
| 11 | 71,3 | 71,3 | 71,5 | | —1198 | |
| 12 | | 72,7 | 72,2 | 7 0 A. M. | —1175 | On the following mor- |
| 13 | | 71,6 | 71,3 | | —1185 | ning Capt. W. and J. P. |
| Difference of temperature, | rising, 134,6 | | | dilatation | 2171 | Omitting Nos. 7 & 8. |
| | falling, 140,6 | | | do. | 2296 | |

*Third Series, 22nd November. Same Bar.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 72,7 | 72,6 | 72,5 | 11 0 A.M. | — 860 | Barometer 29,99. Wil- |
| 2 | 73,9 | 74,4 | 74,5 | 12 43 P.M. | — 829 | cox and Prinsep. |
| 3 | 213,9 | 212,6 | 212,7 | 2 0 P.M. | +1447 | The micrometer re- |
| 4 | 212,0 | 212,4 | 212,2 | to | +1443 | mained perfectly sta- |
| 5 | 212,0 | 212,4 | 212,2 | | +1443 | tionary for half an hour, |
| 6 | 212,0 | 212,4 | 212,2 | 4 0 P.M. | +1443 | and the steam-cocks |
| | | | | 5 | | were not touched. |
| 7 | 76,3 | 81,8 | 80,0 | 5 0 P. M. | — 774 | rejected, not evenly cool. |
| 8 | 70,7 | 71,7 | 71,8 | 9 0 A. M. | — 926 | next morning. J. P. |
| Difference of temperature, | rising, 138,9 | | | dilatation | 2288 | |
| | falling, 131,5 | | | do. | 2218 | single reading. |
| | 140,7 | | | do. | 2370 | following morning. |

*Fourth Series, 23rd November. Same Bar.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 72,9 | 73,2 | 73,9 | 11 57 A.M. | — 897 | Barometer 30,02. |
| 2 | 72,9 | 73,4 | 73,9 | | — 896 | Wilcox and Prinsep. |
| 3 | 212,3 | 212,5 | 212,3 | 12 17 P.M. | +1394 | |
| 4 | 212,5 | 212,5 | 212,3 | | +1394 | |
| 5 | 211,9 | 212,4 | 212,2 | | +1387 | |
| 6 | 212,7 | 212,5 | 212,2 | | +1379 | |
| 7 | 212,8 | 212,4 | 212,2 | 1 25 P.M. | +1379 | |
| 8 | 75,5 | 76,5 | 76,7 | 4 15 P. M. | — 872 | rejected. |
| 9 | 72,0 | 73,4 | 72,8 | 11 0 A.M. | — 920 | following morning. |
| Difference of temperature, | rising, 138,7 | | | dilatation | 2283 | |
| | falling, 139.2 | | | ditto. | 2306 | |

*Fifth Series, 24th November. Same Bar.*

| Number of Observations. | Thermometers, in the Steam-pipe. | Thermometers, inserted in the Bar. North end. | Thermometers, inserted in the Bar. South end. | Hour of Reading. H. M. | Micrometer Readings. Divisions. | Observations. |
|---|---|---|---|---|---|---|
| 1 | 72,8 | 72,9 | 73,2 | 11 40 A.M. | — 906 | |
| 2 | 72,5 | 72,9 | 73,3 | 11 43 ,, | — 906 | Barometer 30,02. |
| 3 | 73,3 | 74,1 | 74,1 | 0 45 P.M. | — 890 | Wilcox and Prinsep. |
| 4 | 212,3 | 212,9 | 212,5 | 1 8 ,, | +1401 | |
| 5 | 212,5 | 212,9 | 212,5 | 1 20 ,, | +1401 | |
| 6 | 212, | 212,6 | 212,4 | 1 45 ,, | +1395 | |
| 7 | 211,5 | 212,7 | 212,4 | 2 0 ,, | +1394 | |
| Difference of temperature, | rising, 139,2 | | | dilatation, | 2298 | |
| | falling, 139,5 | | | ditto. | 2283 | taking readings of 26th. |

*Sixth Series, 26th November. Same Bar.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 71,3 | 71,5 | 71,9 | 10 A. M. | — 916 | |
| 2 | 72,9 | 73,1 | 73,9 | 11 25 A.M. | — 875 | Barometer 30,02. |
| 3 | 73,3 | 74,1 | 74,2 | 0 30 P.M. | — 865 | Wilcox and Prinsep. |
| 4 | 213,0 | 212,3 | 212,3 | 1 0 ,, | +1418 | |
| 5 | 212,3 | 212,3 | 212,0 | 2 0 ,, | +1405 | |
| 6 | 212,9 | 212,4 | 212,2 | 2 15 ,, | +1400 | |
| 7 | 212,5 | 212,2 | 212,1 | 2 40 ,, | +1388 | |
| Diff. of temp., | rising, 139,1 | | | dilatation, | 2288 | |
| | falling, 139,7 | | | ditto. | 2288 | following morning. |

*Seventh Series, 27th November. Same Bar.*

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 70,5 | 71,0 | 70,9 | 10 0 A.M. | — 910 | |
| 2 | 72,3 | 73,2 | 73,0 | noon. | — 875 | Barometer 29,92. |
| 3 | 73,0 | 73,6 | 73,5 | 0 30 P.M. | — 869 | Wilcox and Prinsep. |
| 4 | 212,2 | 212,5 | 212,1 | 1 0 ,, | +1422 | |
| 5 | 211,7 | 212,4 | 212,0 | 1 30 ,, | +1408 | |
| 6 | 212,2 | 212,5 | 212,0 | 1 45 ,, | +1404 | |
| 7 | 212,7 | 212,5 | 212,0 | 2 0 ,, | +1398 | |
| Difference of temperature, | 139,7 | | | dilatation, | 2293 | |

The accordance of the observations, particularly of the latter series, was so satisfactory as to render their further repetition superfluous: it now only remains therefore to arrange the data of the several experiments in a tabular form, and to calculate the resulting dilatations according to the usual expression of "the dimensions taken by a bar at 212°, whose length, at 32°, is 1,000000."

*Abstract of the results of the foregoing experiments on the expansion of the Standard* 10 *feet Bar of Iron.*

| No. of the series. | Range of Temperature Farh. | Divisions of the micrometer. | Total expansion in decimal parts of a foot. | Dimensions of a bar at 212° whose length at 32° is 1,000000. | difference from the mean in millionths |
|---|---|---|---|---|---|
| | ° | | | | |
| 1 r | 136,0 | 2213 | .0090980 | 1.001204 | — 14 |
| 2 r | 134,6 | 2171 | .0089253 | 1.001194 | — 24 |
| f | 140,6 | 2296 | .0094392 | 1.001208 | — 10 |
| 3 r | 138,9 | 2288 | .0094064 | 1.001219 | + 1 |
| f | 131,5 | 2218 ? | .0091185 | 1.001248 | + 30 |
| f | 140,7 | 2370 ? | .0097435 | 1.001246 | + 28 |
| 4 r | 138,7 | 2283 | .0093858 | 1.001218 | 0 |
| f | 139,2 | 2306 | .0094804 | 1.001226 | + 8 |
| 5 r | 139,2 | 2298 | .0094475 | 1.001222 | + 4 |
| f | 139,5 | 2283 | .0093858 | 1.001211 | — 7 |
| 6 r | 139,1 | 2288 | .0094064 | 1.001217 | — 1 |
| f | 139,7 | 2288 | .0094064 | 1.001212 | — 6 |
| 7 r | 139,7 | 2293 | .0094269 | 1.001214 | — 4 |
| | | | Mean of the whole, | 1.001218 | |

The mean of these experiments is 1.001218, but if two of the series (doubtful because they depend on single observations), be struck out, the dilatation will appear to be 1.001213, and the greatest deviation hardly amounts to the one hundred-thousandth part, while the general accordance is much within these limits. The mean of the former experiments upon an iron rod of 25 feet in length was 1.001256, determined by a single heating, and therefore liable to some uncertainty: that of another wrought iron bar to be noticed presently, was 1.001216, which agrees so closely with the above, as well as with the results of Smeaton and Lavoisier, that I am inclined to think there is not so much variation due to the quality of the metal as has sometimes been supposed, and that 1.001215 may be safely employed on all occasions as the *constant of expansion* for wrought iron.

II.—*Expansions of Gold, Silver, and Copper.*

Having concluded the experiments upon the standard bar of the trigonometrical survey, it occurred to me as very desirable to make use of the microscopes, while fixed, to lay off a duplicate of the bar for deposit in my own office. When this had been done, it followed that the constant of expansion might likewise be determined with ease for the new bar by a repetition of the same process;—and further that we might arrange alongside of the iron bar such other metals as were readily procurable in the mint of the desired dimensions.

Captain Wilcox kindly undertook to assist me in this new series, which was conducted in every respect with the same attention to minute accuracy as before. We prepared in the mint two laminated straps; one of pure gold*, 10 feet two inches long, $2\frac{3}{4}$ inches broad, and about $\frac{1}{8}$ inch thick, weighing about 320 lbs: the other of standard silver ($\frac{1}{12}$ copper alloy), of the same dimensions or a little thicker.

The two ends were cut away, and marked with fine dots as nearly as possible at the distance of 10 feet apart. As the run of the micrometer was only one half of the expected expansion of the metals now to be tried, the precaution was taken of inserting second dots about $\frac{1}{10}$th of an inch within the first, the distance between the two dots being carefully measured under the microscope. I have said that the inner steam cylinder was of copper; all that was necessary therefore to enable us to measure the expansion of this metal along with the rest, was to fix two small tongues to the two extremities of the tube, projecting under the focus of the microscopes, and bearing the marks for measurement.

For consistency I will insert the new series of experiments with the same detail as before, to enable other experimenters to judge of the measure of confidence due to our simple but somewhat tedious investigation.

*Eighth Series of Experiments on Expansion.*

| Day. | Thermometers. In Bar. South. | In Bar. North. | Steam pipe. | Readings of the micrometer. Iron. | Gold. (add 2525.) | Silver. (add 2277.) | Copper. (add 2297.) | |
|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | | | | | |
| Nov. | 76,0 | 76,6 | 76,4 | —904,5 | —891,5 | —906 | —959 | |
| 30. | 76,2 | 76,7 | 77,6 | | | | | |
| Noon | 211,7 | 212,2 | 213,2 | + 1290 | —758,5 | +358 | —140 | r. |
| | 211,9 | 212,2 | 213,2 | | | | | |
| to | 211,8 | 212,1 | 213,8 | | | | | |
| | 211,9 | 212,2 | 214,3 | + 1275 | | | | |
| 5 P. M. | 211,8 | 212,1 | 213,0 | | —776 | +360 | —129 | |
| | 211,8 | 212,0 | 211,2 | + 1269 | | | | |
| | 211,9 | 212,1 | 212,7 | + 1279 | —768 | +362 | —129 | |
| | 211,9 | 212,0 | 214,0 | | | | | |
| 1st Dec | 72,9 | 71,6 | 71,4 | — 1023 | —960 | —937 | —1058 | f. |
| 7 A. M. | 72,4 | 71,6 | 71,6 | | | | | |
| Ascending range, 135,6° | | | dilatation, | 2182 | 2649 | 3543 | 3133 | |
| Descending do. 139,9 | | | ditto. | 2301 | 2718 | 3574 | 3222 | |

*Ninth Series.*

| Day. | South. | North. | Steam pipe. | Iron. | Gold. | Silver. | Copper. | |
|---|---|---|---|---|---|---|---|---|
| Dec. 1. | 76,0 | 75,6 | 76,5 | — 967 | —913 | —864 | —979 | |
| Noon | 76,2 | 76,0 | 76,5 | | | | | |
| | 211,6 | 212,2 | 213,4 | + 1266 | —798 | +358 | —157 | |
| to | 211,8 | 212,1 | 214,4 | + 1267 | —799 | +365 | —141 | |
| 4 P. M. | 211,9 | 212,1 | 212,2 | + 1254 | —805 | +364 | —197 | † |
| Ascending range, 136,0 | | | dilatation, | 2229 | 2637 | 3503 | 3098 | |

* Of the old gold mohur standard, or 1 car. $3\frac{1}{4}$ gr. Br., which, as far as such experiments go, may be deemed pure.

† Before this experiment, the hole had been pierced through the copper cylinder.

I should have premised, that to prevent the straps of gold and silver from curving within the cylinder, when heated, they were held flat, one on each side of the iron bar, by coils of copper wire at distances of six inches apart—these were not so tightly bound as to impede free motion longitudinally.

At this period of the experiments it was determined to *anneal* the gold and silver bars, to observe what difference would be caused in their rate of dilatation thereby, as well as what would be the permanent elongation due to this change of condition.

To effect the annealment of such long slips of metal in the most equable manner without endangering loss or accident, required certain precautions. They were laid upon a flat bar of wrought iron, supported at distances of a foot asunder by fire-bricks, as represented in fig. 4, Pl. vii. Their whole length was then enveloped in *gobar*, or cakes of cowdung, in the same manner as is practised in heating the felly of a wheel. The heat was thus gradually raised, until the whole length was uniformly of a glowing red. But, not to lose the opportunity which this experiment afforded of ascertaining the relative expansions of the three metals at this higher temperature, an iron stake had been firmly fixed in the ground at one end of the bars, against which all three were made to abut firmly: the other ends were connected by an intermediate brass rod (kept cold) with the nonius of a sliding scale placed on the ground in a line with the bars, so as to measure off their elongation with great facility. The results, and the temperature by Farenheit's thermometer founded on the assumption of an equal rate of expansion throughout the scale of each metal, were as follows.

| | Absolute expansion in inches. | Deduced temperature. |
|---|---|---|
| The gold, placed uppermost, ........ | 1.638 | 1787° |
| The silver, in the middle, .......... | 2.008 | 1655 |
| The iron, undermost, .............. | 1.240 | 1609 |

That the upper position was much hotter than the lower was evident, nor does it seem surprising that the difference of temperature should have been so much as 180 degrees. No knowledge therefore could be gained on the point sought, namely, the relative ratios of expansion; but the method of operating is itself capable of further application, and I hope hereafter to be able to pursue it to more conclusive results.

The absolute elongation of the precious metals, by annealment, was measured by placing them once more under the microscopes at the same temperature as before, (77°.2.) It was found to be much less than was calculated from the difference of specific gravity before and after annealment, shewing that the compression under the rollers was in the gold 20, in the silver 8, times greater in the transverse than in the longitudinal direction. The results were as follows:

| Specific gravity | hard. | annealed. | Increase of volume. | Elongation by annealment, in parts of an inch. | Elongation by annealment, in decimal parts of 10 feet unit. |
|---|---|---|---|---|---|
| Pure gold, | 19,313 | 19,136 | ,00925 | ,01973 | ,000164 |
| Silver, $\frac{1}{12}$ alloy, | 10,404 | 10,239 | ,01611 | ,08244 | ,000687 |

To compare the relative expansions, the increase of bulk, or volume, must be divided by three, to reduce it into linear elongation, when, as before stated, the transverse will be found much to exceed the longitudinal expansion.

Having explained the objects and results of this digression, and imagining the bars replaced as before, we will proceed to the remainder of the experiments with the steaming apparatus:

*Tenth Series.*

| Day. | Thermometer, in bar, south. | Thermometer, in bar, north. | Thermometer, in steam. | Readings of the micrometer. Iron. | Gold (add 2525) | Silver (add 4065) | Copper (add 2297) |
|---|---|---|---|---|---|---|---|
| | ° | ° | | | | | |
| Dec. 3. | 78,5 | 78,3 | | — 937 | —449 | +865 | —965 |
| | 79,2 | 79,2 | | | | | |
| Noon | 212,1 | 211,8 | 211,5 | +1279 | —383 | +224 | —240 |
| to | 212,0 | 212,0 | | +1267 | —381 | +222 | |
| 5 P. M. | 212,0 | 212,0 | | +1264 | | | |
| | 211,9 | 211,7 | | | | | |
| Ascending temperature, different for each metal, ...... | | | | 133°,6 | 133°,4 | 133°,1 | 132°,8 |
| Dilatation (adding space between dots), ....... ...... | | | | 2207 | 2592 | 3423 | 3022 |

*Eleventh Series.*

| Day. | south. | north. | in steam. | Iron. | Gold | Silver | Copper |
|---|---|---|---|---|---|---|---|
| Dec. 4. | 78,4 | 78,4 | }.... | — 911 | —445 | +865 | —977 |
| | 78,6 | 78,6 | | | | | |
| 10 A. M. | 212,3 | 212,0 | full | +1278 | —377 | +227 | —203 |
| to | 212,2 | 212 | steam | +1266 | —401 | +220 | —202 |
| 3 P. M. | 212,1 | 212,1 | (steam | +1204 | —404 | +175 | —226 |
| | 211,9 | 211,9 | less) | +1202 | | | |
| Range of temper. ascending, .. | | | | 133°,7 | 133°,7 | 133°,7 | 133°,5 |
| Ditto for last readings,...... | | | | 133,6 | 133,6 | 133,6 | 133,5 |
| Dilatation, first readings, .... | | | | 2183 | 2593 | 3423 | 3071 |
| Second ditto, .............. | | | | 2114 | 2566 | 3375 | 3048 |

In this last series the steam was allowed to run down on purpose to try the effect: and it will be seen that it was sensibly felt by all the metal bars, even while the mercurial thermometer scarcely indicated the fall; for as before remarked, the bars were far more sensible thermometers than the small mercurial instruments.

The expansion however by the last experiment has been purposely calculated, to shew the maximum influence of such a cause.

The general results may now be classed under their respective heads as follows:

| | Range of temperature. | Reading of micrometer. | Deduced dilatation for 180 degrees. |
|---|---|---|---|
| Duplicate Iron 10 feet Bar. | 135,6 | 2182 | 1,001191 |
| | 139,9 | 2301 | 1,001217 |
| | 136,0 | 2229 | 1,001213 |
| | 133,6 | 2207 | 1,001223 |
| | 133,7 | 2183 | 1,001208 |
| | 133,6 | 2114 | 1,001171 ? |
| | Mean, rejecting the last, .... | .... | ——1,001210 |
| Pure Gold, rolled hard,.... | 135,6 | 2649 | 1,001446 |
| | 139,9 | 2718 | 1,001438 |
| | 136,0 | 2637 | 1,001435 |
| annealed,...... | 133,6 | 2592 | 1,001439 |
| | 133,7 | 2593 | 1,001435 |
| | 133,6 | 2566 | 1,001421 ? |
| | Mean, rejecting the last, .... | .... | ——1,001438 |
| Standard Silver, $\frac{1}{12}$ alloy, rolled hard, | 135,6 | 3543 | 1,001933 |
| | 139,9 | 3574 | 1,001890 |
| | 136,0 | 3503 | 1,001906 |
| annealed, ...... | 133,6 | 3423 | 1,001896 |
| | 133,7 | 3423 | 1,001895 |
| | 133,6 | 3375 | 1,001869 ? |
| | Mean, rejecting the last, .... | .... | ——1,001904 |
| Copper annealed, but partially hammered in making tube, ............... | 136,6 | 3133 | 1,001697 |
| | 141,5 | 3222 | 1,001685 |
| | 135,8 | 3098 | 1,001688 |
| | 132,8 | 3022 | 1,001684 |
| | 133,7 | 3071 | 1,001702 |
| | 133,5 | 3048 | 1,001690 |
| | Mean of the whole, ...... | ...... | ——1,001691 |

It must be remarked with regard to this series, that, besides other sources of error, the dots, marked with a needle-point by an unskilful hand, were rather difficult to bisect; and further, the continual shifting of the apparatus, to bring each bar successively under the focus of the microscopes, was more than sufficient to account for irregularities greater than are observable in the present results.

In comparing the list with the former one, one is struck with the close agreement between two metals of very different fusibility, namely, standard silver, and brass; a circumstance which permits the application of silver divided circles to astronomical instruments of the latter metal. Platina is by no means so well adapted for such a purpose. The operation of annealing does not seem to have the slightest effect upon the rate of expansion, a fact well worthy of consideration, as it would be at all times difficult to say what allowance should be made on such account, where the degree of hardness of a metal might be uncertain.

The latest determinations of the dilatations of metals (which have reached me since the above experiments were finished), are those of Mr. Daniell; but the apparatus used by him, (a plumbago tube of six inches in length, holding a rod of the metal to be operated on,) however well adapted for approximate measurement of intense heats, is obviously not worthy of trust for minute measures at low temperatures, I do not therefore insert his table from the Philosophical Magazine now before me, but at once conclude with a general summary of the dilatations which our experiments in India have established, in a manner worthy, I hope, of entire confidence.

*Dilatations of metals determined at Calcutta.*

| | | | |
|---|---|---|---|
| IRON, | Standard 10 feet bar of the Trig. Survey, | 1,001213 | 1,001215 |
| | Duplicate of do. of English bar iron, .. | 1,001210 | |
| | Wire-drawn rod, twenty-five feet, .... | 1,001256 | |
| GOLD, | nearly pure, (10 feet long) .................... | | 1,001438 |
| SILVER, | containing one-twelfth alloy, (do.)................ | | 1,001904 |
| COPPER, | sheet, annealed, .......... (do.)................. | | 1,001691 |
| BRASS, | wire-drawn, annealed, (25 feet) ................ | | 1,001906 |
| LEAD, | one-inch pipe, (25 feet) ................ ...... | | 1,002954 |

The apparatus used in the foregoing experiments is preserved, in case it should ever become a desideratum to try the expansion of other metals or substances by the same process.

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## IV.—*Continuation of Dr. J. Gerard's Route with Lieutenant Burnes, from Bokhára to Meshid.*

[Extracted from letters to his brother Captain P. Gerard.]

*Mírabád*, 31*st July*, 1832. We took leave of Bokhára on the 21st ultimo, and are now in a Túrkoman village, about 36 miles distant, awaiting the arrival of the merchants, &c. who are to form the *Kafila;* but we may be here long enough, as the *Urganj* army is still in our way. Ghos Bég sent for us before starting, and made us over to the Túrkomans and *Kafila bashí*, with every demonstration of good will, and enjoining them to convey us safe to *Meshid* at their peril. * * * *

The weather has been uniformly sultry;—thermometer daily above 100°, even as high as 110°, and our sitting room is but a few degrees cooler, but the extreme dryness of the air counteracts the sensation of heat. The nights have generally been pleasant and the mornings always temperate;—thermometer 66°. Though it is now the middle of August, the climate can scarcely be said to have changed, except that the nights are cooler.

*Meshid*, 17*th September*, 1832.—Here we are safe in Persia, after a journey of no ordinary difficulty. We left the village *(Mírabad)* so long our prison, on the 16th of August, and crossed the Oxus on the following morning, intending (as we had believed upon faithless resolutions), to accomplish the trip in fifteen or sixteen days. Our first detention commenced at *Sarjué* on the bank of the river, but as this was not occasioned by any untoward event we cared less. Other *Kafilas* joined us here, and on the 21st we resumed the journey across the desert. The weather had undergone a great change, and was now temperate. We almost immediately entered amongst sand heaps, which succeeded in rising heights, and extended till they bordered the horizon on all sides; and the *Shimal* or north wind sweeping away the loose surface, made it appear like the sea spray, while the heaps themselves represented the waves. The camels trod heavily through the sand drifts, and the horses plunged as if they were fording a river. Several belts of this sort occurred between them, tracts of sand covered with bushes or shrubs, and then a ridge of the desert composed of hillocks or sand waves, which at a distance looked like a vast *roller* just going to break. Scarce any track is visible, the wind defacing the prints of the camels' feet; but there is a general line of route which is followed. The sand heaps are of every size and shape, but have commonly their cliff to the south; deep chasms are formed by the junction of their bases, and basins or cavities which would resemble pools if filled with water. The scene was quite new and magnificent. It was altogether a wilderness. We passed several dead carcases of camels and horses, the drivers of which, having missed the wells, killed some of them for sustenance. Most of the wells were saliferous, but the water answered for our horses and some of the people, who live little better. The climate had evidently turned from its extreme temperature, and in this respect we had not to complain. The nights, contrary to expectation, were very mild. A very long march brought us to a well of bad water, after having been without any except what we brought from a distance. This was a relief the more grateful, as we had nearly missed the spot, and perseverance alone in *feeling* for the road kept us in a proper direction, till the barking of a dog announced our proximity to a Túrkoman camp. On the 27th we reached a baked arid plain, on which was planted a tented village of Túrkomans. Here we were to be taxed by the *Urganj* authorities, who came down to us from the ancient city of *Máwur* or *Myhr*, now almost level with the face of the desert, and no longer an inhabited spot. The *Urganj* army was close upon us, but on their homeward route. On the 28th the collector arrived, and inspected the *Kafila*. The merchants presented him, as customary, with various articles: we sat mute in our camel panniers, and were duly reported as *Musáfirs* upon a pilgrimage to the places of fire worship; our offering to the taxman consisted of loaf sugar and tea. Our prodigality was nearly ruining us; fortunately a Russian merchant (a Mahomedan who traded to Russia, whose avarice had conquered all pride of self-sufficiency), from a regard to his own interests, checked our liberality, and instead of presenting a couple of sugar-loaves and a handful of tea, broke off the end of one, and with a few raisins made up our *nazar*.

Several of his train peeped into our creels and asked after our business, and were quite satisfied on being told that we were Afghans from *Kabúl*: so little are those people acquainted with the colour and characteristics of Europeans. In this respect, therefore, our faces are real masks, and it was here only the name of our country that we had an object in concealing, since to the services of those in Abbas Mirza's army especially, not a little of the bad feeling between the Khan of *Urganj* and the Persians is owing. Russians and Englishmen are alike their enemies, or rather the *Urganjís* are hostile to both. In the afternoon we ventured out of our camel baskets as the enemy was departing, but as some of his dependents were lingering behind we were warned back. In the evening we got out and laughed heartily at the transaction. In truth we were quite at our ease all the time, not believing that there was an individual in our camp who had any object in betraying us; but it was not long till we discovered that wretches are to be found in every community, and people whose fair faces belie their feelings. We had only a week's march between us and *Meshid,* and we started again with fine prospects.

On the 1st of September we came in sight of the mountains of Persia, and next day arrived at *Shiraks*, a Túrkoman village with a fort. Here we were to be taxed, but misfortunes seldom come single; and if the merchants had to complain of an imposition, we certainly had not bargained for a share of their burdens and a load of our own besides. While in our former embarrassment near *Myhr*, we superadded to it the pleasant prospect of meeting a body of Allemans, whom the merchants of our *Kafila* actually saw marched off upon a predatory excursion to the borders of *Meshid.* The tax-gatherer, who had an interest in the safety of the *Kafilas*, exacted a promise from them, that should they cross our path we had nothing to fear: but a robber's pledge is like lover's vow graved upon some insect's filmy wing, and lasts only till the bait is thrown out. No fewer than seven hundred of those armed ruffians were thus let loose. At *Shiraks* we learnt that the Allemans were still in pursuit of booty, and the *Kafila* took up its position till they should have passed us on their return. Apprehensions were now turned into real horror, at least with me, when we beheld the cold-blooded monsters racing into the village, with their spears poized and their horses almost dead from fatigue in their infernal occupation. They brushed past our encampment, some of them stopping and conversing with the *Kafila*, and relating their adventures to the merchants, who in pursuance of their trade took a heartless interest in that of the robbers, as upon their success more or less would rest their own security. Upwards of 100 Kuzlbashes were seized for the *Bokhára* market, and a number of camels and cows which they drove off from within sight of the walls of *Meshid*. Their encampment was close to us, and we were almost tempted to take a look at it. Some of the Allemans were disabled, while their horses were scarce able to carry them. Many had returned empty-handed, finding the work too heavy; all those who touched at the village came for refreshment or to visit their friends. This is a strange state of society, yet these intrepid adventurers, when seen in the ordinary relations of life, are not only sociable companions, but even prepossessing in their natural simplicity and easy manners. The guard of Túrkomans we had were the same people, and every individual of it could enumerate his exploits in the inglorious field; but this is perhaps not quite fair, as it requires a considerable share of courage to meet the various perils of their vocation: pillage alone is their aim, and, of all others, human beings are their greatest prize; nor is it much to be wondered at that, amongst people who are naturally prone to rapine, their fellow creatures should be most coveted, as long as the infamous markets of *Bokhára* and *Urganj* offer a premium for the traffic. The Russians have, I believe, succeeded in restraining slavery as regards *Bokhára*: but what reliance is to be placed upon any compact that is both adverse to mercenary interests and religious zeal? There are several hundred Russian slaves now in the dominions of the *Bokhára* dynasty, and as long as Túrkomans offer them for sale there will be purchasers; and what does Russia know of her black population or of her fugitive soldiers, who wander amongst half savage hordes at the extremities of her territory? At *Shiraks* there was a Persian girl of unquestionable beauty who had been in slavery for a couple of years, with the Túrkomans of course; her transfer was delayed in hopes of an enhanced price, and a *Kafila* which followed us, picked her up at what may appear a high valuation, if indeed we can make any estimate of what is in itself unappreciable! But you will excuse me for treating the subject in this loose way, having resided so long in a quarter of our own dominions where female slavery is as notorious as the sun at noon day, and if not quite so glaring, is, I fear, scarcely less remarkable, while it is as genial to the people's feelings as his rays to their frozen solitudes. The Persian girl was sold for upwards of 60 *tilas*, more than 420 rupees, a sum that would purchase at least a dozen of females in the Himálayan regions. When this infernal traffic is so profitable, can we expect that the hungry Túrkomans of the desert will restrain their cupidity for human flesh ?—but this is a subject for sages in their closet, and not for travellers.

Our detention at *Shiraks* till the roads were cleared of lingering robbers was necessarily prejudicial to us, as we were still in the *Urganj* territories, though virtually subject to Abbas Mirza: but you may judge of his authority by the successful obtrusions of the Túrkomans even to the gates of this holy city. Our protests against imposition on the previous occasion of paying taxes had given umbrage to several of the merchants, who seemed to have leagued together to make what they could of us; and finding us still self-confident, had recourse to the mean tricks natural to the trade, and betrayed us. We were now to be locked up in the fort till the Khan of *Urganj* sent for us; and at first we saw nothing but certain misfortune, slavery at the very least, and we prepared for flight with the evening's twilight at the risk of falling into the hands of the Allemans, or half perishing for thirst in the desert. When thus turning over our thoughts, one of the merchants, a Persian, whose state of health had made him extremely grateful for our curative attentions, relieved us from our suspense, and, together with the avaricious Russian trader, offered to conciliate the Túrkoman chiefs, and pass us off as pilgrims or any other species of wanderers. A couple of *tilas* and a little tea and sugar, with sweet words, satisfied their expectations; but fortune favoured us more than our presents, as it happened that our friend the Persian was a most intimate acquaintance of the very people who pressed us so closely. Having got out of this snare, we divested ourselves of every comfort we might have had over our fellow travellers, sat in the sun or in our creels, and ceased to cook our dinner as usual, as the fire collected a swarm of Túrkomans as a candle does insects. Still delayed, new difficulties arose, a plot to extort money or tea was again begun, and our apprehensions of rumours of our disguise reaching the chiefs of the *Urganj* army were too well grounded. A fresh body of Allemans had issued from *Máwar*, and were approaching *Meshid;* our consternation was further raised on learning that Abbas Mirza's *Elchee* (ambassador) on his way to *Herát* was seized by the very people we were amongst, and was actually a prisoner in irons in the village, so that on every side we were environed by difficulties of one sort or other; at last a *Kafila* from *Meshid* made its appearance, and our irresolute associates got under weigh, much to our satisfaction, after nine days of the most irksome durance, though we were not entirely without amusement during part of the time, but upon the very threshold of a friendly port such provoking interventions were quite unsupportable. Even here we were obliged to take in a supply of water. On the 11th we resumed our journey, and on the 12th crossed the mountain frontier of Persia or rather Khorasan, which is continuous with the hills which trend along the Oxus and run into *Hindu Kush*. They are about 4,000 feet in height (water boiling at $205\frac{3}{4}°$), and support the plains of Persia which have a very considerable elevation.

At midnight of the 12th we were thrown into confusion by a report of an encampment of robbers. The *Kafila* closed up in a great hurry; the camels were instantly squatted upon their knees and packed together; the utmost regularity prevailed; fear having overcome their surprise, both men and beasts were silent; the camels, as if they had been accustomed to such scenes, trembled and sat still. The armed men stood in front waiting the assault. I found myself close to a pair of women who were bustling about seeking comforters, but I felt rather abashed in such company, and making my way over camels' backs and bales of goods got outside, followed by our *Haji Baba*, who though a very respectable man in his calling had no idea of showing fight, and entreated me to make myself snug; but his alarm was soon allayed, for the enemy was not forthcoming, and the people we dreaded were equally afraid of us. They were travellers like ourselves. Had they been Allemans we should have made but a poor figure in the contest, for not half of us would have come to the scratch, as the phrase is, and too surely the remainder would not have kept it up after the first onset. In the evening we were within ten miles of *Meshid*, and before making a final start of it, a custom-house officer paid us a visit, and delighted us by intimating that Captain Shee was at *Meshid*, where news of some kind or other must await us; but as Abbas Mirza was besieging a fort in the neighbourhood, we could not reconcile the report. An hour before day-break on the 14th saw us at the gates of this city, and we are now amongst Persians all gay and courteous, a new scene entirely,—no more Usbeks! We were very fortunate in having met with Mrs. Shee here, who invited us to breakfast and dinner, and shewed us every attention and kindness. There is also a serjeant in charge of the arsenal, who is particularly useful to us; he has engaged to keep a register of the thermometer here for me. We are going out to the prince's camp, 100 miles from this. He has just taken a fort, and concluded his campaign. Lieut. B. will thence go on to *Tehran*, but I must return here and start with a *Kafila* for *Herat*. The road is far from safe, but

I only require to be with the *Kafila* to be protected. This is a fine city: the scene is entirely new. I am forced to make an abrupt conclusion to be ready for the *Chop* (post). * * *

10th October, I have been at the prince Royal's camp, about 90 miles from this. Lieut. Burnes there left me for *Astrabad* and the Caspian. We found Captain Shee, Mr. Brouski and Mr. Beck in camp, all living in the Persian style: they were very kind to us. Captain Shee and I went to the Turquoise mines, and since my return to this I have not been very well. Every body here is also sick. My journey to *Herat* is all fixed. I saw Yar Mohammed Khan, Prince Kamran's minister, who received me extremely civilly, but I am cautious in putting myself under any obligations."

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## V.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 27th March,* 1833.

The Honorable Sir Edward Ryan in the Chair.

The Proceedings of the last meeting were read.

Lieut. A. Burnes, Assistant Resident at Cutch, was elected a Member.

C. Telfair, Esq. President, and Mons. J. Desjardins, Secretary, of the Natural History Society of Mauritius, were on the favorable report of the Committee of Papers, elected Honorary Members.

Read letters from Captain Henderson and Mr. F. J. Halliday, expressing their reluctance in being obliged to withdraw from the Society.

Read a letter from J. C. Morris, Esq. Secretary to the Madras Literary Society, &c. requesting that copies might be made for the use of Cavelly Venkata Lachmia pundit, formerly in the employ of Colonel Colin Mackenzie, of the English Catalogue of the late Colonel's collection of inscriptions.

*Ordered* that such information as can be given, regarding the Translations of Colonel Mackenzie's collection of inscriptions, be forwarded in reply to the Mad. Lit. Soc.

The Secretary announced that materials were collected for another volume of Researches, and that it was for the Society to determine whether it should continue to publish in the same form as heretofore.

The Native Secretary submitted a memorandum on the subject, of which the following is the substance:—

The first five volumes were printed by the Calcutta Gazette Press on its own account, and copies supplied to Members at 20 Rs. each, after which the Society took the responsibility of publication. Until 1810 a charge was made for the volume; thenceforward Subscribing Members received their copies gratis.

The sale of the Researches either in India or in Europe has been very limited. The cost of printing, gradually reduced from Rs. 10,000 to Rs. 4500 per volume, has amounted from the time that the Society became its own publisher to, Rs. 82000

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| While the return by sales has been | in England, Rs. | 3200 | |
| | in India, | 6000 | 9200 |

leaving a balance of loss on 13 volumes, Rs. 72,800

Baboo Ram Comul Sen proposed that in future the matter for publication should be transmitted to Europe, where a printer may be found to print it on his own account, Mr. Wilson kindly correcting the press*.

After some discussion a Committee composed of Dr. J. Tytler, Major Benson, Dr. J. T. Pearson, and Mr. J. R. Colvin, was appointed to consider on the best mode of publishing the continuation of the Researches.

Extract of a letter from J. F. Royle, Esq. to the Secretary was read, announcing the intended publication of his "Illustrations of the Botany and Physical Geography of the Himalaya mountains and Kashmere."

*Library.*

The following books were laid on the table :—

Transactions of the Royal Society of Edinburgh, vol. xi. 2nd part, and vol. xii. 1st part—*presented by the Society.*

Professor Buckland's account of the animal and vegetable remains and of rocks collected in Ava by Mr. Crawfurd—*by the author, through Dr. Wallich.*

Ditto on the occurrence of the remains of elephants, &c. in the frozen mud of Behrings Straits—*by ditto.*

Proceedings of the Royal Asiatic Society at the Anniversary Meeting of Saturday, 7th June, 1832—*presented by the Society.*

Proceedings of the Mauritius Natural History Society, for September and October, 1832—*by the Society.*

Journal Asiatique, No. 56, August, 1832—*from the Asiatic Society of Paris.*

Meteorological Register for February—*from the Surveyor General.*

*Syr-ul-Mutakherin,* 1st volume—*presented by the publisher and editor, Mulvi Abdúl Mojíd.*

Anglo-Persian Anecdotes, translated by Krishnachundra Ghose.—*Presented by Raja Kálikrishna Buhádur.*

The following works, received from the Oriental Translation Fund of Great Britain and Ireland.

Fraser's Annals of the Turkish Empire, from A. D. 1591 to 1659, 1st vol.

Stewart's *Tezkereh al Vákiát,* or Private Memoirs of the Moghul Emperor Humáyún, 1 vol.

Klaproth's *San Kokf Tsou Ran To Sets,* ou Aperçu general des trois Royaumes, with a volume of plates.

Stenzler's *Raghuvansa,* Kalidasæ Carmen, Sanskrité et Latiné, 1 vol.

The Geographical works of *Sadik Isfahani,* translated by J. C.

Juliĕn's *Hoei Lan-ki,* ou l'histoire du cercle, de craie, drame en prose et en vers, 1 vol.

* This is however hardly a fair way of stating the case: the members are in fact the purchasers of the Society's volumes, which they pay for by their subscriptions. Publication is the main object and the main expence of every literary association; without which it would be of comparatively little utility or interest to the world.

Col. Brigg's *Siyar-ul Mutakherin*, a History of the Mahommedan Power in India during the last century, 1st vol.

Atkinson's Shah Nameh of Firdausí, translated in verse and prose, 1 vol.

Fourth Annnual Report of the Oriental Translation Fund.

The following books received from the book-sellers:

Gray's Indian Zoology, part xii.

Lardner's Cyclopedia, Spain and Portugal, vol 4.

*Natural History.*

1. Dr. Wallich, Superintendent H. C.'s Botanic Garden, presented in the name of Professor Buckland, specimens of the *coprolite*, or fossil *album-græcum*, from the *lias* of Lyme-regis, Dorset.

Some of these fossils are in their rough state, some are cut and polished, and there are plaster casts of other specimens in Dr. B.'s collection.

2. A fragment of fossil bone, brought by himself from Jabalpúr, was presented by Major Benson.

This fragment is enveloped in a hard greenish siliceous coat, which has also penetrated into the pores of the bone in many parts, and has taken the place of its animal matter, probably by the same process of infiltration which is observed in fossil wood from the same part of India.

3. A further selection of the fossil shells of the Himalaya were received from Captain P. Gerard, on the part of his brother, Dr. J. Gerard.

Several of these shells differ from those depicted in the Rev. R. Everest's paper in the Physical Transactions, and will form the subject of a supplementary plate.

Read extract of a letter from Lieut. Burnes, presenting specimens of Asbestos found between Pesháwar and Kabúl;—

Ditto Native Muriate of Ammonia from the province of Hissar, north of the Oxus;—

Ditto of the sand or silt suspended in the river Oxus;—

Ditto of sand from the Kharasm Desert between the Oxus and the Caspian.

The President communicated the following circular, with a request from the Rev. W. Whewell of Cambridge, for any information which Members of the Asiatic Society might be able to supply on the subject of the tides of the Indian Coasts.

*Suggestions for Persons who have opportunities to make or collect observations of the Tides.*

"It was shewn by Newton, nearly 150 years ago, that the fact of the Tides and several of their circumstances, resulted from the law of the Universal Gravitation of matter. But in this interval of time scarcely any thing has been done which might enable us to combine into a general view the phenomena of the Tides as they take place in all the different parts of the world; and at very few places have good and continued observations been made and published. It is conceived that by collecting such observations as have been made, or may easily be made, the connexion and relation of the Tides of all the parts of the Ocean may be in a short time clearly made out; and that persons may be induced to make such careful observations as may serve to be compared with the theory. In this hope the present paper is circulated.

The most useful Observations with reference to our general knowledge of the Tides are the following, beginning with those which are most easily made :

1. The Observation of the Time of High water at a known place, on any day, and especially at new and full moon.

2. The Observation of the Time of High water on several days in succession at the same place.

3. The Observation of the Height of several successive Tides at the same place.

4. Observations of the comparative Time of High water on the same day at different places in the same seas.

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1. An observation of the TIME of High water at a given place on *any* known day may be useful.

If the Time of the *Moon's southing* on the same day be noted, this will facilitate the use of the observation, and will furnish an additional evidence of the correctness of the date.

The Time of High water on the days of *New and Full Moon* is more particularly useful than on other days.

Observations of the Time of High water may be made with sufficient accuracy without a tide-post. A place ought to be selected where the water is tolerably smooth.

2. If there be opportunity at any place, it is desirable to observe the Time of High water *every day for a fortnight.*

If it be ascertained that the two tides on the same day occur at regular intervals, *one* of them only need be observed.

But there are often irregularities in the relative Times of the morning and evening Tide ; and these irregularities are different for different ages of the moon. In this case *both daily Tides* should be observed.

3. A single observation of the Height of the Tide is not of much value. But a *Series* of Heights *for a fortnight* is valuable, especially if accompanied with observations of the times.

The morning and evening Tide are often unequal, and this inequality sometimes varies considerably from one fortnight to another.

In observations of the Height of the Tide, the *difference of High and Low water* ought to be taken.

The channel of a river is *not* a good situation for such observations.

4. The usefulness of tide observations will be greatly increased if those made at places in the same seas can be compared so as to shew the RATE *at which the Tide wave* TRAVELS :

For example, the time which it employs in passing along a certain line of coast, or across a sea, or round an island, or up a bay.

N. B.—The Tide wave is the elevation of the waters by which High water is produced in many places at once. It is not observed as a visible wave, but is found by drawing a line upon the globe through all the places at which it is high water at a certain moment. The rate and direction of its travelling are known by comparing the position of such lines at successive times.

N. B.—The RATE *at which the Tide wave* TRAVELS is quite distinct from the rate at which the stream of ebb or flow *runs.*

N. B.—Also the DIRECTION in which the Tide wave travels is quite distinct from the direction in which the tide *ebbs* or *flows.*

The most proper observations for determining the rate and course of the Tide wave are those of the Time of High water *on the same day at different points* (not too near nor too remote) on a continued line of coast or sea.

This may often be done by a person residing in any country by making enquiries of persons conversant with the coasts, or by directing corresponding observations to be made at different places for a few days only.

If the places differ much in longitude, this ought to be noted, that allowance may be made for the difference of the absolute time of noon.

If there be any uncertainty as to the rate and course of travelling of the tide between two places, the doubt may best be removed by obtaining observations at some intermediate point or points.

It is necessary to distinguish the Time of High water at the *mouth* of a deep bay or sound, from the time of High water further in. The former is to be taken in all such comparisons as are here spoken of.

Large islands and long promontories much disturb the regular progress of the Tide wave.

Comparative Observations of the *Height* at different places in the same seas, especially if combined with those of the Times, may also be of great value.

All communications concerning any observations of the above kinds made or to be made in any part of the world will be thankfully received. They may be addressed to the care of the Sec. Asiatic Society, or direct to

The Rev. W. Whewell, Trinity College, Cambridge ;
or, at the Royal Society, London ;
or the Astronomical Society, London."

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The President read a letter handed to him by Dr. Strong, addressed to Major Benson, Mil. Sec. to the Right Honorable the Governor General, describing the progress and present condition of the borings in Fort William, with the opinion of Sergeant Reid upon the causes of the repeated failures ; and suggesting that the Government should continue the experiment upon its relinquishment by the Society : Major Benson explained that the present reference to the Society had for its object to obtain their opinion as a body upon four essential points before recommencing operations ;—the probability of ultimately finding a spring ;—the expediency of making the further attempt ;—the mode of avoiding such accidents as have hitherto impeded the auger :—and the estimated expense.

After some discussion, the following members were nominated a Committee to draw up a report with advertence to these points. Dr. Mill, V. P. Dr. Wallich, Dr. Langstaff, Mr. Seppings, Captain Forbes, and Dr. Casanova.

*Antiquities.*

Read extracts of a letter from Lieut. A. Burnes, presenting to the Society eleven of the coins collected by himself in his recent visit to Manikyala.

Two or three of these coins are in excellent preservation, with very decypherable Greek inscriptions, and are thus proved to be of Bactrian fabrication :—they bear the several devices of the equestrian figure ;—the man in the tunic ;—the elephant ;—&c. and agree in other respects with the coins described in Mr. Wilson's paper plate II. Nos. 25, 26, 27, 28, &c.) : there are others of a pure Hindee character ; but as Lieut. Burnes will soon be in Calcutta with the remainder of the coins procured by him, any further notice may better be deferred until his arrival.

*Literary.*

A paper was read on the marriage rites and usages of the Jâts of Bharatpúr, by G. T. Lushington, Esq.

The marriage of Balwant Sinh, the present Raja of *Bharatpúr*, to the daughter of the Bechore Raja, in May 1832, afforded the author an excellent opportunity of witnessing the numerous ceremonies punctiliously observed in its solemnization at Deeg. Mr. Lushington describes the betrothal—the *tika* or marriage present—the settlement of a fortunate day by the pandits, and the consequent transmission of the *lagan patri*, or bride's horoscope, to the bridegroom, which is considered to close the marriage. Connubial feasts and concerts are then given in the parents' houses. The youth is anointed with jasmine oil, and makes pooja and offerings to the family *potter's wheel*, to *Sitla* the goddess of the small-pox, and to the *gohra* or place in which the filth of the palace is deposited : this is said to typify the increase of progeny, as the heap of rubbish continually augments! The ceremony of the *bhat* succeeds, in which *rice* and other presents, of horses, elephants, &c. are given to the *parohits*, the Rani and Rajâ and their attendants, by the brothers and other male relations. Deputations from foreign courts succeed. The *Barát* or marriage procession starts from the temple of the bridegroom's *mahant* or head priest (he had not a family *gúrú*), and is attended with much splendour. Upon its arrival at the bride's house the ceremonies of *táran* and *hom* take place. The former consists in striking the image of a bird with a sheathed sword ;—the latter, the burnt-offering and adoration of water, are described as the most interesting parts of the performance—they are followed by the *Kanyadán* or giving away of the bride—the *Pradakshana*, the *Aghuna*, and the marriage hymns.

The bride is then carried home, when feasting and curious games, resembling " snapdragon and bran-cake," amuse the young couple.

After three days' residence with her lord, the bride returns to her parents for three or five years, when she is brought away with the ceremony of *gona* or *gaman*—but this may be dispensed with by the performance of *phir-pattah*, or changing the stools of the bride and bridegroom when the *hom* is celebrated.

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## VI.—MADRAS LITERARY SOCIETY.

*General Meeting held at the College on Saturday, 26th January, 1833.*

The Hon'ble Sir R. Palmer, President, in the Chair.

The Secretary (J. C. Morris, Esq.), laid before the Meeting a statement of the funds of the Society in both its branches.

Captain Chase, Lieut.-Col. Coombs, A. Robertson, Esq. and Capt. Rowlandson, were elected the Committee of management.

W. Hudleston, Esq. and Capt. Rowlandson, were added to the Committee of papers.

Donations of various books from individuals and societies,—of a Baudha image and a gold coin, were announced.

Seventeen new members had been elected since the last general meeting, and fourteen had retired and gone home.

Read letter from Messrs. Arbuthnot and Co., stating that they are prepared to receive the model of a pagoda the property of John Hodgson, Esq., which that gentleman has requested may be transferred from the Madras Literary Society to the Royal Asiatic Society.

Ordered that the model of the pagoda in question be forwarded to Messrs. Arbuthnot and Co., and that a letter be addressed to the Royal Asiatic Society, explanatory of the delay which has occurred in its transmission.

Read letter from Lieutenant Chalmers, forwarding a translation from the Persian of the 1st volume of the Akbar Namah of Abool Fuzl.

Resolved, that Lieutenant Chalmers be informed that on receipt of the second volume, the Society will be prepared to submit his work to the favourable notice of the Oriental Translation Committee of the Parent Society in England.

Read letter from the Baron De Ferussac, requesting to be furnished through the medium of the Society with some information regarding Minerals and Shells, in order to enable him to finish a work he is engaged in on these subjects.

Resolved, that the Baron De Ferussac be informed, that the Society will use their best endeavours to meet the views and wishes expressed in his letter.

Read letter from Cavelly Venkatah Lutchmiah, submitting a letter from Sir Alexander Johnston, and requesting assistance from the Society.

Resolved, that Cavelly Venkatah Lutchmiah's letter be referred for the consideration and report of the Committee of Papers.

Read list of books presented to the Society by a Jain Priest.

Ordered to be referred to the Committee of Papers.

Read letter from the Honorary Secretary to the Royal Asiatic Society, acknowledging the receipt of several communications, and returning the Society's thanks for the same.

Ordered to be recorded.

Resolved, that all letters and communications which either from inadvertence or other causes may hitherto not have received answers, be immediately replied to, with suitable apologies; and that it be publicly notified that all communications, however short, which may in any way tend to elucidate the history and sciences, arts and customs of the natives of India, whether Hindús or Mahomedans, will be thankfully received by the Society, will receive ready attention from the Committee of Management, and will be read at the quarterly meetings of the Society.

Resolved, that with the view of increasing the efficiency of the operations of the Society by stimulating its supporters to exertion, regular meetings be held on the second Thursday of the months of February, May, August and November, for the purpose of reading the several communications which may be received, and of selecting such as may be most deserving of publication.

Proposed by Lieutenant-Colonel Coombs, seconded by Mr. McDonell, and carried by acclamation—

"That this meeting hail with peculiar satisfaction the presence of The Right Honorable Patron of the Society, and beg to return him their grateful and respectful acknowledgments for his promised countenance and support."

The thanks of the meeting were unanimously voted to the Honorable the President, for his able conduct in the chair.

## VII.—*Miscellaneous.*

### 1.—INDIAN BOTANY.

*Extract—Proceedings of the Linnæan Society, 5th June.*

The East India Company have presented to the Linnæan Society their magnificent Herbarium, containing the plants collected between long. 73° to 114° E. and lat. 32° N. to the equator, by König, Roxburgh, Rüttler, Russel, Klein, Hamilton, Heyne, Wight, Finlayson, and Wallich. It includes about 1300 genera, more than 8000 species, and amounts, in duplicates, to at least 70,000 specimens,—the labours of half a century.

For many years a large portion of these vegetable riches were stored on the shelves of the India House, without any one sufficiently conversant in Indian Botany to arrange and render them subservient to the cause of science. On the arrival in this country of Dr. Wallich, the distinguished superintendent of the Company's Garden at Calcutta, in the year 1828,—who brought with him an immense accession to the Herbarium from various parts of India, especially Nipal and the Burmese Empire,—the Court of Directors instructed him to make a Catalogue of the aggregate collection, and to distribute duplicate specimens to the more eminent Societies and naturalists throughout Europe and America.

This immense labour has occupied Dr. Wallich for the last four years; and it is the chief selection from these various Herbaria, destined for the museum of the India House, which the Court of Directors have, with princely munificence, presented to the Linnæan Society.

The liberality of the East India Company has been duly appreciated throughout the wide circle of science. It has been acknowledged by letters and addresses from the different Societies and individuals honoured by their patronage; and this last act of their bounty will endear them still more to the promoters of Botany, by placing the treasures they possessed along with those of Linnæus and Smith.

The Linnæan Society purchased, two years ago, at an expense of 3000*l.*, the collections of Linnæus and of the late excellent Sir J. E. Smith; and since that, the Herbarium of the Society having been further enriched by the treasures of the East, it forms collectively one of the most interesting and important in Europe.

The East India Company have set an example of a wise and liberal policy, which will be followed throughout the world, not only by Societies, but by those enterprising individuals who have, to their own honour, made large collections of the objects of natural history; and it is a source of national congratulation that at this moment the naturalists of Europe feel indebted to this country for the most extensive contribution that was ever made to their botanical collections. We owe this general feeling of respect towards us to the enlightened conduct of the Court of Directors, who have done more to diffuse a knowledge of Botany than was ever done by any Government or association of persons on the globe.

A deputation from the council of the Linnæan Society, headed by the President Lord Stanley, waited on the Chairman of the Court of Directors, on the 26th instant, with an address expressive of the high sense the Society entertains of the honour conferred upon it by the liberality of the East India Company.

*Dr. Royle's Collections.*

We are happy to perceive by an announcement made at the last meeting of the Asiatic Society, and which we have inserted in the advertisement sheet of the present number, that Mr. F. J. Royle is about to give to the world the fruits of his laborious researches in the Botany and Natural History of the Hills and the upper provinces of India. We trust that his work will meet with a full portion of the public patronage, without which it would be ruinous to attempt the publication.

### 2.—Indian Geology.

*List of the specimens of Rocks from the Tenasserim Archipelago, situated between the Parallels of* 10° 50′ *and* 12° 10′ *N. presented to the Society,* 15*th Jan.* 1831. *By Lieut.* Lloyd, 1*st Assistant to the H. C. Marine Surveyor General**.

No. 1. *Clay slate*, from a small detached islet on the western side of Sullivan's Island, in Lat. 10° 54′ N.

No. 2. *Fine grained granite,* decomposing, from a rock on the western side of the same island, and distant about two miles more to the northward ? its top has a very whitish appearance, perhaps from the action of the sun and salt-water.

No. 3. *Quartz rock*, from a rocky islet on the eastern side of Sullivan's Island, immediately opposite to No. 1, and distant from it about one mile, the breadth of the island in that part.

No. 4. *Granitic sandstone*, from a small island of a reddish brown appearance, situated on the western side of Sullivan's Island, in Lat. 10° 58′ N.

No. 5. *Sandstone*, from a point on the western side of Sullivan's Island, near to the last.

No. 6. *Slate*, from a point on the eastern side of an island named by Captain Ross " Lord William Bentinck's Island," in Lat. 11° 40′ N. It does not shew the principal formation of the island, but merely a lump or patch on the point, and very easily separated with the hand, being in regular horizontal layers.

No. 7. *Quartz rock*, from two hill islands situated off the N. end of Sullivan's Island, in Lat. 11° 1′ N.

No. 8. *Granite*, from the Alligator dry rocks, which are situated off the N. end of two islands, called by Captain Ross, " Sir Edward Owen's and Sir John Malcolm's Island."

Nos. 9 and 10. *Granite*, from Sir Edward Owen's Island, the former from the eastern side, in Lat. 11° 13′ N. and the latter from the north side, in 11° 15′ N.

No. 11. *Granite*, from Sir John Malcolm's Island, in Lat. 11° 16′ N.

No. 12. *Limestone*, (similar to that of Elephant rock, in the Quedah country, described by Ward,) from a small round and steep island, in Lat. 11° 16′ N. and situated on the eastern side of Sir John Malcolm's Island.

No. 13. *Jasper conglomerate*, from the Northern Elephant Island, of which there are four large and other smaller ones, between Lat. 11° 32′ and 11° 36′ N. They are from 6 or 700 to 1000 feet high, and resting on small bases, appear at a distance like large peaked rocks : the northern one stands in six fathoms water, its sides project outwards, so as, in parts, to admit of a boat getting underneath, and the rugged pieces of the rock beneath, at a little distance, resemble stalactites, of which the specimens are pieces that have been knocked off.

* This list should have been printed with the proceedings of the same date, but the localities were not at that time known to us ; they may now be found immediately by reference to Captain Ross's Chart of the Tenasserim Archipelago.

No. 14. *Quartz* and *micaceous schist,* from the S. side of a small island, in Lat. 11° 47′ N. It is covered with trees of a great variety of foliage, and producing many berries it attracts numberless pigeons of a beautiful cream colour, with wings and tails tipped with black; and from this circumstance it has been called Pigeon Island.

No. 15. *Granite,* from a small island on the south-eastern side of Sir Edward Owen's Island, in 11° 11′ N. This island, when I visited it, was covered with "Tucans."

Nos. 16 and 17. *Limestone* and decomposing *Granite,* from two small islets distant from each other ½ a mile, in Lat. 11° 49′ N.

No. 18. *Micaceous schist,* from rocks that cover and uncover with the tide, near to the last.

No. 19. *Micaceous schist,* from a small island, in Lat. 11° 50′ N. and has only one or two fathoms on its summit, which gives it the appearance of a cap and feather.

No. 20. From an island in 11° 53′ N. It is formed by two hills connected by a narrow sandy ridge, so that, at a distance, it appears like two small islands. The specimen is taken from the south-west point of the western hill, the summit of which has an even and flatish appearance.

No. 21. *Fine grained granite,* from rocks on the western side of Christmas Island, in 12° 0′ N.

No. 22. *Quartz,* from a small island, in Lat. 12° 4′ N. (Hospital Island.)

No. 23. *Quartz,* from the north-east point of an island to the westward of it.

No. 24. *Decomposed granite,* from a small island, in Lat. 12° 9′ N.

### 3.—INDIAN ARTS AND MANUFACTURES.

*Mode of dyeing Kharwa Cloth, practised in Bundelkhand. Translated from a Persian account. By Babú* Harí Mohun Sén.

To dye—say one bale of cloth, consisting of fifty-two pieces, the first step to be taken is to wash them white in water. Thirteen seers of oil of castor, three seers of impure soda *(khak-ij-zamín-shôr,* efflorescence on saline earth), and fifteen seers of clear water, must then be mixed together, and the cloths dipped and drenched in the solution twice a day for four days continually. At the expiration of that time, the same operation is to be renewed for a period of seven days, soaking the same in the liquor, and reducing the operation to once a day. But care should be taken to put into it a little saline earth every day during the process. After this, the whole bale of cloths must be rewashed in clear water, and then steeped over again in another liquid composed of water and three seers of *Halelah* (*Terminalia Chebula*), and afterwards dried. A similar cold solution of water and three seers of alum is then to be prepared, in which the stuffs are again to be steeped, and afterwards well dried. After all these operations are duly conducted, a caldron or large vessel is to be filled with a sufficient quantity of water, in which are to be mixed one maund and ten seers of *Al (Morinda Tinctoria),* a dye-wood, and five seers of *Dháwa* (another wood). The former should be well dissolved previously to the cloths being submitted to the process of dyeing. After they have taken a deep dye in this liquor, they should be taken out of the vessel, and then washed with soap and water. Then a solution of eight seers of gum is to be made, and the stuffs immersed and washed in it for the last time. They are afterwards to be folded piece by piece, and rubbed and scoured with a little gum over their surface, and then beaten in order to make them smooth and compressed.

*To dye cloths of an* Amua-sabz, *or mangoe-green color.*

The cloths require first to be dyed in a solution of indigo; the latter to be used at the rate of two chitaks on an average per piece. Afterwards they must be boiled in water with a mixture of rind of pomegranate in it. In this operation, half a seer of the latter should be mixed for each piece. They are then to be steeped in a strong solution of water and alum, which should be given in two chitaks on an average. After this, a preparation of two chitaks of turmeric dissolved in water should be made, and the stuffs kept dipped in the same for one whole night. In the morning following, they must be washed in clear water, and lastly dyed with the juice of *Kúsum* flower, which when first extracted is naturally yellow, and which is termed " *Pin*" in Hindústaní. They are afterwards to be folded and beaten smooth.

*The dyeing of Súrj Pakhi, a red yellow—the color of a bird so called.*

A composition comprising ten seers of oil of castor, five seers of impure soda, *(khák-i-zamín-i-shôr)* one seer of goat's dung; to be made, and to be all dissolved in a sufficient quantity of water. Twenty pieces of stuff are then to be washed in pure water, in a vessel all separately, and one by one, changing the water every time. This operation is to be kept in continuance for fifteen days. They must afterwards be washed in clear water, and soaked in a solution of alum and water. Twenty-five seers of powder of *Al* should then be dissolved in a necessary quantity of water, in a large vessel, and the cloths steeped and coloured in the liquor. They are thus to be wrought up for the space of six days, and finally dried and folded.

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### 4.—*Note on Lieut. Burt's instrument for trisecting Angles.*

On reading the papers on the trisection of angles, in the number for November last, I observed some inaccuracies, which as they were overlooked in the last number, I now beg leave to bring to notice.

Mr. Burt, in proving the correctness of the instrument, has made the truth of the demonstration depend on a position which is itself in want of proof. He says, (page 500, l. 8), " rad. *bo*-rad. *ao*," but they are not necessarily equal from the construction, and it should therefore be proved that the locus of the point *b* is in the arc *abc*. The demonstration is consequently faulty. I think however the instrument will effect the purpose intended; and perhaps when I have more leisure, I may attempt to prove its accuracy, if not anticipated by some one whose avocations are more in accordance with such pursuits. Mr. B. says that A B the fourth leg of the instrument, may be dispensed with. I do not think it can, but I don't understand this part of the paper, nor do I see how a line can be *parallel* to one or two others, and also pass through the same point with them.

I have not tried to construct the instrument, but I should anticipate some difficulty in applying it, as one may not readily know when the points A and O respectively coincide with *a* and *o*.

I am, Sir,

Your obdt. servt.

A. K.

## *Meteorological Register kept at the Assay Office, Calcutta, for the month of March*, 1833.

| Day of the month. | Barometer reduced to 32° Farh. At 5 A. M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Thermometer in the Air. Minimum at 5 A. M. | At 10 A. M. | Max. by reg. Ther. | At 4 P. M. | At 10 P. M. | Depression of moist-bulb Thermometer. At 5 A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | Hair Hygrometer. At 10 A. M. | At 4 P. M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 29,865 | ,876 | ,785 | ,868 | 72,4 | 77,7 | 87, | 86,0 | 72,2 | 2,4 | 6,2 | 20,4 | 5,9 | 92 | 57 | | o. | w. | S. | stratus. | clear. | o |
| 2 | ,845 | ,878 | ,741 | ,850 | 72,1 | 79,2 | 82,2 | 85,7 | 75, | 0,9 | 5,0 | 17,9 | 2,8 | 94 | 65 | | o. | s. | S. | scud. s. | scud. | o |
| 3 | ,749 | ,864 | ,765 | ,902 | 72,6 | 81,5 | 88,4 | 88,8 | 77, | 0,9 | 6,7 | 18,4 | 2,9 | 92 | 67 | | s. | s. | S. | ditto. | cister. | o |
| 4 | ,851 | ,894 | ,768 | ,907 | 77,2 | 80,2 | 88, | 87,3 | 78,2 | 3,0 | 5,0 | 14,0 | 3,4 | 93 | 83 | | o. | s. | S. | stratus. | cumulus. | o |
| 5 | ,904 | ,911 | ,791 | ,886 | 75,0 | 80,6 | 88,7 | 87,5 | 77,8 | 1,8 | 12,2 | 20,1 | 4,3 | 78 | 59 | | o. | S. | n. w. | o | o | gathering |
| 6 | ,853 | ,874 | ,770 | ,880 | 73,0 | 83,0 | 88, | 89,4 | 78, | 1,0 | 7,5 | 21,6 | 4,0 | 92 | 64 | | s. | s. | S. | stratus. | cumulus. | scud. |
| 7 | ,822 | ,848 | ,745 | ,850 | 75,2 | 83,3 | 94,2 | 87,0 | 76,8 | 2,0 | 8,0 | 18, | 1,8 | 91 | 70 | | S. | s. | S. | o | o | o |
| 8 | ,818 | ,880 | ,774 | ,856 | 76,5 | 84, | 92,5 | 85,2 | 77,6 | 1,7 | 7,0 | 13,6 | 4,4 | 89 | 75 | | o. | o. | S. | cirrus | o | o |
| 9 | ,846 | ,872 | ,760 | ,832 | 75,5 | 84, | 95,2 | 87,0 | 78, | 1,7 | 7,5 | 15, | 3,8 | 87 | 72 | | s. | s. | S. | cistr. | o | steady. |
| 10 | ,787 | ,800 | ,691 | ,847 | 75,2 | 83,2 | 95, | 87,5 | 79,2 | 2,2 | 9,2 | 17, | 3,0 | 85 | 71 | | s. | s. | S. | stratus. | o | bank. |
| 11 | ,824 | ,859 | ,741 | ,808 | 76, | 82,7 | 97,2 | 91,0 | 77,2 | 4,0 | 12,7 | 18,6 | 3,0 | 81 | 70 | | S. | s. | S. | ditto. | cirri. | o |
| 12 | ,755 | ,758 | ,595 | ,697 | 75,1 | 81,9 | 1005 | 90,2 | 81,8 | 1,4 | 4,3 | 15,2 | 5,5 | 95 | 75 | | S. | s. | s. w. | hazy. | haze. | o |
| 13 | ,691 | ,768 | ,657 | ,767 | 77, | 81,4 | 94,8 | 89,3 | 75,4 | 2,2 | 19,1 | 13,5 | 7,2 | 65 | 56 | | o. | n. w. | S. | ditto. | o (nwr.) | o |
| 14 | ,721 | ,844 | ,741 | ,859 | 73,5 | 81,9 | 95, | 88,2 | 77, | 4,5 | 17,2 | 22,0 | 3,8 | 65 | 58 | | o. | n. w. | s. w. | o | o | o |
| 15 | ,804 | ,887 | ,776 | ,890 | 73,2 | 85,0 | 93,6 | 87,9 | 77,5 | 1,2 | 10,8 | 13,5 | 3,3 | 84 | 78 | | s. w. | s. | S. | fog. | o | |
| 16 | ,843 | ,864 | ,752 | ,865 | 75,3 | 82,1 | 96,1 | 88,2 | 78,4 | 1,6 | 6,1 | 14,7 | 2,4 | 93 | 74 | | e. | s. | S. | o | o | heavy scud. |
| 17 | ,841 | ,872 | ,786 | ,867 | 77,0 | 83, | 96, | 89, | 78,8 | 1,9 | 6,2 | 16,5 | 4,3 | 94 | 73 | | S. | | S. | o | o | o |
| 18 | ,848 | ,897 | ,769 | ,895 | 76, | 84,0 | 101,2 | 92,5 | 82, | 3,5 | 6,3 | 21,1 | 6,2 | 92 | 62 | | S. | s. | S. | o | o | o |
| 19 | ,818 | ,836 | ,720 | ,766 | 75,2 | 85,8 | 97, | 94,0 | 77,2 | 2,0 | 12,2 | 19,2 | 5,6 | 81 | 70 | 0,03 | S. | n. w. | S. | o | o | storm se. |
| 20 | ,793 | ,850 | ,721 | ,819 | 77,8 | 85,0 | 98, | 91,0 | 80,8 | 2,8 | 7,8 | 19,5 | 5,1 | 89 | 65 | | S. | s. | S. | stratus | o | o |
| 21 | ,795 | ,855 | ,721 | ,800 | 77,2 | 85,8 | 99, | 95,0 | 80,2 | 6,4 | 10,3 | 13,6 | 4,0 | 89 | 60 | | e. | o. | S. | o | o | o |
| 22 | ,794 | ,860 | ,719 | ,826 | 78, | 84,7 | 100, | 91,0 | 80,9 | 2,0 | 7,0 | 19,4 | 3,5 | 90 | 62 | | S. | o. | S. | cum. | o | o |
| 23 | ,851 | ,867 | ,736 | ,841 | 78, | 86,2 | 100, | 91,7 | 82,0 | 4,0 | 13,5 | 16,3 | 3,7 | 75 | 69 | | o. | s. | w. | o | o | o |
| 24 | ,829 | ,870 | ,760 | ,826 | 78,5 | 85, | 101,3 | 88, | 83,2 | 2,9 | 14, | 16, | 6,0 | 75 | 70 | | w. | | s. w. | o | | bank s. w. |
| 25 | ,810 | ,871 | ,777 | ,839 | 80,3 | 84,6 | 95, | 86,7 | 78,3 | 11,6 | 14,3 | 16,0 | 9,9 | 75 | 73 | | n. w. | n. w. | e. | cum. | cirrostr. | cum. |
| 26 | ,821 | ,871 | ,752 | ,835 | 74,5 | 82,4 | 94, | 89,5 | 79,7 | 7,5 | 12,6 | 16,8 | 14,4 | 82 | 72 | | n. | n. w. | n. | o | o | o |
| 27 | ,854 | ,935 | ,820 | ,901 | 72,8 | 83,5 | 92, | 89,7 | 78,2 | 10,3 | 15,7 | 19,1 | 10,2 | 72 | 67 | | o. | o. | o. | o | o | o |
| 28 | ,871 | ,905 | ,763 | ,815 | 73,5 | 84,5 | 94,8 | 89,9 | 77,0 | 10,0 | 11,2 | 17,1 | 4,0 | 83 | 72 | | o. | n. w. | s. | o | o | o |
| 29 | ,787 | ,842 | ,720 | ,813 | 77,2 | 85,6 | 97, | 90,8 | 80, | 11,8 | 8,2 | 20,5 | 6,5 | 89 | 62 | | s. | s. w. | S. | fog. | o | o |
| 30 | ,767 | ,865 | ,771 | ,848 | 78,9 | 87,0 | 95,8 | 89,6 | 79,4 | 2.7 | 8,0 | 14,4 | 1,7 | 90 | 77 | | S. | S. | S. | o | cirri. | circum. |
| 31 | ,821 | ,901 | ,780 | ,900 | 77,2 | 89, | 95, | 91, | 78,4 | 1,2 | 15,0 | 16, | 2,5 | 85 | 75 | | S. | s. | S. | haze. | hazy sky. | do. |
| Means, | ,815 | ,860 | ,747 | ,844 | 75,7 | 83,5 | 94,8 | 89,2 | 78,5 | 3,6 | 9,8 | 17,3 | 4,9 | 85 | 70 | 0,03 | | monsoon. | | | fine pleasant weather. | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory, and the Sunday entries are filled in by interpolation. The instruments for 5 A. M. and 10 P. M. are observed daily in the south veranda of a house near the Cathedral—on the 7th these latter were removed to the third story of the same house, in a more airy situation. The Barometer is corrected for the difference of height, it stands ,020 lower than the Surveyor General's instrument.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 16.—*April,* 1833.

### I.—*Account of the Jain Temples on Mount Abú in Guzerát.* *By* Lieut. Burnes, *Bombay Army.*

The mountain of *Abú, Abují,* or *Abúghad,* is situated near the 25th degree of north latitude and 73° 20′ of east longitude, in the district of *Sekrúí* and province of *Márwár,* about 40 miles N. E. by E. of the camp of *Dísa.* The magnificent temples are erected at the small village of *Dilwarra,* about the centre of the mountain, which has an elevation of about 5000 feet, where the summit is extremely irregular and studded with peaked hills. There are four in number, all of marble, and two of them of the richest kind. They are dedicated to Párasnáth, or "the principal of the deified saints, who according to their creed have successively become superior gods," and who are believed to amount to the number of twenty-four, or as some told me, to have appeared, like the Hindú gods, in twenty-four different *Avatárs.*

These are the gods of the *Jain, Shráwak,* or *Banian* castes, who are a gloomy tribe of atheistical ascetics, not unlike the Budhists, "who deny the authority of God and a future state; believe that as the trees in an uninhabited forest spring up without cultivation, so the universe is self-existent; and that the world, in short, is produced, as the spider produces his web, out of its own bowels; and that, as the banks of a river fall of themselves, there is no supreme destroyer." "They also deny the divine authority of the *Védas,* and worship the great Hindú gods as minor deities only:" but Mr. Colebrooke and other eminent scholars have already given the most minute description of this class of people and their worship. The above abstract of their tenets will at once show how little acceptable the followers of Párasnáth can be to orthodox Hindús; and the costly materials of Jain temples are therefore attributable, not to the holiness of the gods to whom they are dedicated, but to the riches that are to be so generally found among the *Banians* their votaries.

Jain temples are to be met with in *Guzerát, Kattywár, Cutch* and *Parkur*, as well as in other countries both in the southern and northern parts of the Peninsula, but next to those on *Abú*, the most celebrated ones on the western side of India, are at *Politana* and *Girnar* in *Kattywár*, at both of which places also they have been built on the tops of hills. The antiquity of the schism between this and the Hindú sect is not accurately ascertained, but the oldest temple on *Abú* appears to have been built An. Vicramajit 1016, (A. D. 960,) or something more than eight hundred years ago.

The temple now alluded to is dedicated to Rikabdeo, (or as Mr. Ward has it, "Rishubhu-devu,") the founder of the sect and first in order of their deified saints, and is known by the name of *Adísurjí deval*. The four temples are built in the form of a cross, and this is the most westerly. It is in the figure of an oblong square, forty four paces long by twenty two wide (or perhaps 100 feet by 50); within the building, and in the centre of the area so inclosed, stands the pagoda, in which the great image of the god is placed facing eastward. In front of this there is an octagon of 24 feet, supporting, on pillars and arches of marble, a cupola of the same. The pillars may be from 12 to 15 feet high. The entrance to the temple is from a small door opposite this cupola, and the grandeur of the building is discoverable at once on entering it, and has a very imposing effect. On all sides of the area there is a colonnade, the long sides having a double row of pillars supporting small domes, within each of which are cells in the walls to the number of 56, in all of which are marble images of the god. In the south west corner, and in a chamber detached from the building, is a colossal figure of Ne'mináth cut in black stone.

The whole of the building is of the richest white marble, superbly cut into numerous devices; and it is worthy of remark that there is not an inch of stone unornamented, and not two domes of the same pattern, though one hundred and thirty-three in number, and all are carved. The grand dome is a most chaste piece of workmanship, and so light do the pillars appear, that it could hardly be imagined they could support the superincumbent weight.

Adjoining to this building is a room called "*Háthísál*" or the elephant hall, which seems once to have also had a roof of domes, and in which are the figures of ten marble elephants with drivers, each about four feet high, and caparisoned in the modern style of those of the Native princes, with every rope, tassel and cloth beautifully and correctly carved, and apparently, the cars and riders excepted, from one block of marble. The workmanship is exceedingly good, and the representation of the animal is very superior to Indian sculpture in general.

The floor of this room is of black marble, while that of the temple is of white. At the door there is a large equestrian statue of the founder, who by an inscription, is described as "BI'MALNÁTH, a *Banian* of *Chandoulí* to whom the gods had been propitious." It is rudely executed, and is evidently the workmanship of later days.

The whole of this temple is said to have occupied a period of fourteen years in building, and to have cost eighteen crores of rupees, in addition to fifty six lacs spent in levelling the side of the hill on which it is built.

The next temple to be described is the northern one, which is dedicated to NE'MINA'TH, the twenty-second deified saint of the Jains. It is with regard to design and material much the same as the one mentioned, but although of equal length it is ten paces wider, from which addition the architect has been able to make the colonnade double on all sides without contracting the area too much, and which has a good effect. The pagoda of the god is in the centre, and faces the west. It has also a cupola in front of it, the same as the other in size, though far inferior in execution : but the greatest ornament in this temple, and indeed on *Abú*, is a portico between this cupola and the pagoda. It is supported by pillars, and the roof is formed by nine small domes most exquisitely carved. The stones on both sides the entrance of the temple are deeper cut than any marble I ever saw, and, if I mistake not, approach in resemblance to Hogarth's line of beauty. This part of the building is said to have cost eighteen lacs of rupees, and I can well credit the people who gave me the information.

All round the temple and in front of the colonnade, small images of the god are placed to the number of forty-six, in front of each of which are two sculptured domes.

The east side of the building is not divided into compartments, but consists of one long room in which are placed ten marble elephants, which are more minutely carved than those described, the very twisting of the ropes being represented. In rear of these are the images of the different contributors to the "holy undertaking," rudely cut out in stone, and represented as holding purses full of money ready to be appropriated. There are inscriptions under all these figures mentioning at length the names of the different "pious individuals," most of whom appear to have been Banians.

In the south western corner of the building are two inscriptions cut in marble and fixed into the wall, but they are in such a good state of preservation that it becomes very questionable if they are of the same age as the temples. They are in the *Bálbad* character, and giving (as I learnt from the people, there being no one who could read them with me,) a genealogical account of the different founders and their relatives. Above the niches containing the smaller images, there are also inscriptions with the names of the builders in *Gúzerátí* character. From all of these it appears that this temple was built, An. Vicr. 1293, or A. D. 1236, nearly six hundred years since, by two brothers, Bast and Fest Pál, *Banians* also of the ruined city of *Chandoulí*, and one of whom is said to have been *Kámdár* to the Delhi Emperor. The building is said to have cost twelve crores of *Sonias*, a coin equivalent to ten rupees, in addition to the expense of the portico; and although it is superior to the other temple, this is undoubtedly an exaggeration.

The sculpture of the small domes in this pagoda, from being of a higher order of architecture than the others, deserves remark. In several of them are representations of the gods, in particular a group of the procession of Indra King of the Gods, who is believed to have descended from heaven at the birth, marriage and installation of Rikabdeo; also another of *Nemináth's* marriage, both of which are pretty well executed in marble. Nothing more attracted my notice, however, than the group next to the one just described, it being a representation of one of the Mahommedan emperors of Delhí. I observed also that very common ornaments throughout the temple were small Mahommedan tomb-stones.

Superstition has however pre-eminently shown itself in the portico. While admiring its beauty I observed the capital of one of the pillars to be of coarse unpolished black stone, which induced me to ask the cause of such a disfiguration; when the people informed me that it had been done intentionally to keep off the evil eye, as in a place like this where all was beauty, it would inevitably fall and become bewitched if there were no foil. The floor of this temple is of mixed marble, being both black and white; and under the great dome there is a slab of yellow marble, said to have been brought from *Jesalmír*.

The two remaining temples are about 365 years old, and very inferior both as to workmanship and materials when compared with the others. Under the dome of the southern one, there is some attempt at mosaic work, and the floor is inlaid with five different kinds of marble.

The whole of these temples are in a good state of preservation, notwithstanding the attempts that have been made to destroy them. The tails, trunks, and riders of the elephants have been broken off, though since replaced; and the dome of Adesirji'-dewal is cracked in one or two places. The earthquake of 1819 is said to have had some effect on these buildings, but although the Brahmans and Jains formerly carried on violent controversies, it does not appear that the former injured the Jain temples. The natives themselves speak with horror of the oppression of a Mahommedan prince known to them by the name of "Bogra Badshah," who is said to have ordered the temples in *Abú* to be levelled. Natives are at all times but bad chronologists, nor are they in this instance able to give any distinct account either of the time or of the individual whose name excites such irritating feelings.

It is on record however that a Sultan of *Ahmedábád* in *Guzerát,* by name *Máhmúd Begra,* sent a force to levy tribute on the Parsees, A. D. 1450, and from the similarity of names, and the connection that subsisted between two such mercantile places as *Ahmedábád* and *Chandoulí,* it does not appear to me at all improbable that this is the individual*. The hand of time is now however fast injuring these buildings, and throughout the marble gives signs of decay.

Without placing too much reliance on the inscriptions above alluded to, there is a circumstance which goes far to fix the date of these temples at a period when the Mahommedan power was great in India. All the figures are throughout represented with beards, which we know to be at variance with Hindú customs, and which is without doubt attributable to the same cause that induces the Hindú subjects of a Mahommedan government to follow the custom of their rulers, namely, submission to the powers that be. In Sind, at the present time, such is the custom of all Hindús, and it is perhaps owing to this that the Moslem rulers ever spared the temples of the submissive people they conquered. It is to the same cause, I presume, that we have the representation of the emperor of Delhi, though from the founder being his "*Kámdár,*" it may be more easily accounted for.

With very few exceptions the people on *Abú* do not worship at the temples of *Dilwárra,* and there are only one or two *Gurjís* at the place, who could give, from sheer ignorance, little or no information concerning the surrounding scene of grandeur. They have, however,

* I should have been more disposed to attribute the injury which the temples of *Abú* have received to Ma'hmúd of Ghizni, who came by Ajmír into Guzerát, in 1024, through *Patan,* and who was so zealous in the destruction of Hindú gods and temples, and has been rendered famous by the demolition of the one at *Patan Somnáth* in Kattywar; but if the inscription be true the whole of these temples, even the oldest of them, are of a posterior date to that conqueror's inroad.

one good quality which our countrymen can well appreciate, a total freedom from all prejudice, so that we entered the "sanctum sanctorum" of the inner temple without a murmur on their part, nor did they object to our handling the gods themselves.

There were besides two inmates of the temples whom I must not omit to mention. They were women who had taken a vow of chastity, retired from the world, and dedicated themselves entirely to religion, or, as they themselves say, had become "*Sadú*." One of them was young, and had retired on the death of her husband. They spent their time in reading their religious books, which they readily showed, and were quite free from that prevailing reserve in Indian women, so much so that they followed us through the "atria" of the temples, and were ever ready to explain, as far as in their power, the different objects of our curiosity.

It was from them I learnt the names of the twenty-four deified saints or gods of the Jains, which are as follows—1 Rikabdeo,—2 Ajilnath,—3 Sambunáth,—4 Abumandjí,—5 Súmtanáth,—6 Padan Prabú,—7 Supárisnáth,—8 Chanda Prabu,—9 Subatanáth,—10 Sítalnáth,—11 Síansnáth,—12 Wáspují—13 Bímalnáth,—14 Anandnáth,—15 Darnnáth,—16 Santínáth,—17 Kutonáth,—18 Aránáth,—19 Milínáth,—20 Muní Subartjí,—21 Nawínáth,—22 Néminátjhí,—23 Párisnáthjí,—24 Mahávarú, and it is not difficult to distinguish by the expressive affix of "jí," even from among this long list, the favored or favorite gods to whom the temples are dedicated.

I also learned from these people, that there are large assemblages of people on *Abú* at different but unfixed periods, and that they chiefly come from Guzerát, Márwár, Ajmere, Malwa and Bombay, all of which except the latter are, in fact, the surrounding countries. The natives of India are, as it is well known, fond of perching their temples on the tops of hills and other remarkable places; and it is no doubt owing, as well to the isolated situation, as the great size of the mountain, that such a position has been chosen. There is, however, no marble on *Abú*, and certainly at present, no roads by which the enormous blocks of it could have been brought up from the pits that are at the base of the mountain, so that it is to be presumed they have been destroyed.

From some specimens in my possession, it would seem that the summit of *Abú* is granite; but great part of the exposed rocks are in a state of decomposition, and break off in flakes.

The vicinity of *Abú*, though now without a large town, has been, as is discoverable from ruins, and according to tradition, a well cultivated and thickly peopled country.

About nine miles from *Girwar*, a village at the base of *Abú*, and half that distance or less from the *Banás* river, are the ruins of a great and ancient city called "*Chandoulí*," said to have been eighteen miles in circumference, and which is now without an inhabitant.

The natives have numerous fabulous accounts concerning the place, and believe it to have been one of eighty-four towns or villages that were destroyed by "a shower of stones" three hundred years ago; and that a famine and scarcity of fuel ensuing, the people fled to *Guzerát*, and settled at *Ahmedábád*. I myself had not an opportunity of visiting the ruins of this city, but am informed that all its buildings are thrown down as if by an earthquake, the occurrence of which could, I have no doubt, be accurately ascertained by inquiry on the spot. Its antiquity may be readily discovered from the temples on *Abú* having been built by the *Banians* of this once opulent city, as proved by the inscriptions before alluded to, and great numbers of small marble images of PÁRAS-N'ATH, the same as those on *Abú*, being constantly dug from among the ruins.

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## II.—*List of Indian Woods collected by* N. Wallich, *M. D. F. R. S., Corresponding Member of the Royal Institute of France, and the Academy of Sciences at Berlin, &c. and of the Society of Arts of London; Superintendent of the Botanic Garden at Calcutta.*

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Dr. Wallich was sent by the Governor-General of India on several botanical missions, especially in 1820-1, to Nipal, a hilly country situated between the lower part of the valley of the Ganges and the Himalaya mountains, and to the Burmese territory in 1826-7. On each of these expeditions he collected specimens of the native woods, which were sent to England, and deposited at the India House. To these were likewise added some that had been grown in the Botanic Garden of Calcutta. On the arrival of Dr. Wallich himself in England, I had the pleasure of forming a personal acquaintance with him, having before occasionally corresponded with him respecting various Indian products that at different times he had sent to the Society of Arts.

Under an apprehension that the arrangement and description of the vast botanical collection brought over by him, would occupy the whole of his granted time of absence from Calcutta, he suggested that his collection of woods should be transferred to the Society of Arts for arrangement and examination. This plan having been sanctioned by the Court of Directors of the East India Company, between four and five hundred specimens were placed in our possession. Here they were examined, and were cut up into three or four sets of specimens more or less complete. Some of them were found to be worm-eaten; and several of those from Nipal being only portions of small branches, are not in a state very favourable for shewing the qualities of wood with reference to its value as timber. Their native names, and the scientific ones of those that have any, as well as the uses to which they are applied by the people of the countries where they grow, were supplied by Dr. Wallich*, partly from his own observation, and partly from a catalogue of Burmese woods collected in 1827 by A. Maingy, Esq., and presented by him to Dr. Wallich. Some notices have likewise been obtained from a catalogue of woods sent by Dr. Francis Hamilton (late Buchanan), from Gualpara in Assam, on the Burrampooter, and which were put into the hands of Mr. James Kyd, master builder to the Hon. East India Company at Calcutta, for examination. These notices are distinguished by the letters *Ham.*, though some of Dr. Wallich's are intermixed with them. The observations on the structure of some of the woods from Nipal were made by myself, and relate chiefly to the longitudinal *fibre*, to the medullary *rays*, to the longitudinal *tubes*, and to the annual *layers*. For some practical observations the Society is indebted to the carpenter employed in cutting up the specimens.

A. AIKIN, *Sec.*

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## CATALOGUE OF INDIAN WOODS.

1 Acacia mollis, fr. Nipal.

A large tree: wood yellowish white, shining, coarse, rather soft.—Sp.† 2 inch. diam. Fibres and rays of the same colour, the latter very distinct: tubes large.

2 Acacia fragrans, fr. Nipal.

A large tree.—Sp. 2 inch. diam. Wood glossy, coarse: a bad specimen.

3 Acacia. Joolchumahl, N.‡ fr. Nipal.

Tree very large: wood excellent for chests and boxes.

4 Acacia. Popeeah, B.§ fr. Tavoy.

A very large tree: the wood used for posts, bows, and rollers for ginning cotton.

5 Acacia. Paingadoo, fr. Tavoy.

* It has been thought better to leave the spelling of the native names as in the original catalogue, since it is difficult to know in many cases how they ought to be rendered orthoepically.—ED.

† Sp. the individual specimen examined.

‡ N. Newar, the language of the Hindú conquerors of Nipal.

§ B. The Burmese language.

6 Acacia odoratissima. Jatikorai, fr. Gualpara.*

Trunk very lofty, but not straight; often 6 feet in girth: wood hard, and used in furniture.—*Ham.*

7 Acacia marginata. Korui, fr. Gualpara.

5 cubits in girth. Makes good planks.—*Ham.*

8 Acer lævigatum. Suslendi, N. Cherouni, P.† fr. Nipal.

30 to 40 feet high: 3 to 4 inches in diameter; of slow growth; used for rafters, beams, and other building purposes.—Sp. 3·5 inches in diam. Wood varied brown and cream colour, with a wavy lustre.

9 Acer sterculiaceum, fr. Nipal.

A very large tree, 3 feet in diameter.—Sp. 3·5 inch. diam. Wood light: fibre pale cream colour, with considerable lustre: rays in distinct brown ribands: tubes large, giving a coarse appearance to the wood.

10 Acer oblongum, fr. Nipal.

A very large tree. Wood moderately hard and compact.—Sp. fibre cream brown, with considerable lustre: rays in narrow ribands of a flesh colour: tubes small.

11 Adamia cyanea. Bansook, P. and N. fr. Nipal.

Wood pale coloured, not used.

Aggur. *See* Aquilaria.

Ain,<br>Aintha. } *See* Dipterocarpus.

12 Ahnaun, fr. Tavoy.

3 to 6 fathoms long; 12 to 15 inches diameter. Yields good crooked timber, the strongest and most durable of any in Tavoy; used for anchors to the largest boats.

Alesi. See Justicia.

13 Alnus nepalensis, fr. Nipal.

Wood as firm as English birch, and of a deeper colour; very hard, and difficult to cut; lustre considerable.—Sp. 5 inch. diam., 20 layers in 1·7 inch (but in another specimen 5 layers in 1·8 inch). Heart pale brownish red: fibre glossy: rays reddish brown, very distinct. Bark fibrous, rather thick, composed of many thin laminæ.

14 Alstonia (Echites) scholaris. Chatiyan, fr. Gualpara.

A beautiful tree, often 3 cubits in girth, used for coarse furniture.—*Ham.*

15 Alstonia antidysenterica (Nerium antidys.). Dudkhuri, fr. Gualpara.

A large tree, often 3 cubits in circumference. Is considered a powerful medicine. Beads are made of it, to be worn round the neck.—*Ham.*

Amari. See Guarea.

16 Anacardium latifolium. Bhela, fr. Gualpara.

Grows to a good size; used for making chests and couches.—*Ham.*

17 Anacardium? Thubbamboo, B. fr. Tavoy.

A large tree, used in boat-building.

18 Andrachne trifoliata. Uriam, fr. Gualpara.

3 cubits in girth, used for coarse furniture.—*Ham.*

19 Andromeda ovalifolia. Angaree, P.; Juggoochal, N.; fr. Nipal.

Grows 1 or 2 feet in diameter: wood soft and spongy, used for fuel.—Sp. wood moderately hard, compact, reddish brown, with some lustre. Bark with layers of stringy fibres.

20 Andromeda formosa. Sheaboge, N. fr. Nipal.

A tree of considerable size.—Sp. 4·5 inch. diam.: wood pale brown, fine-grained, moderately hard; rays very distinct in the outer layers.

* The Gualpara specimens are not as yet in the Society's possession.

† Parbuttea, the language of the natives of Nipal.

21 Andromeda cordata, fr. Nipal.

Sp. 4·5 inch. diam.: wood brown, nearly dull; rays distinct: bark flaky, not at all stringy.

22 Andromeda, fr. Nipal.

23 Andromeda, fr. Nipal.

Angaree. See Andromeda.

Anjoo. See Jasminum.

Annah-beng. See Fagræa.

Antheel. See Ludia.

24 Antidesma. Boro-helock, fr. Gualpara.

Grows in the mountains; 6 feet in girth; the wood used for furniture.—*Ham.*

25 Aquilaria agallochum. Aggur and Langchi, fr. Gualpara.

Attains a great size in the low-lands of Assam, and on the lower hills of Gualpara; but in these situations the wood is white, and in no estimation. In the Garo mountains certain parts of the heart of the wood become of a dark-brown colour, and are strongly impregnated with a highly scented oil. When in this state it is usually called Eagle-wood.—*Ham.*

26 Aralia digitata. Leesaong, N. fr. Nipal.

A rambling shrub.

27 Aralia nodosa, fr. Nipal.

Sp. small, imperfect, and worm-eaten.

28 Aralia, *v.* Panax, fr. Nipal.

Said to be excellent wood; used for boxes and other articles. Sp. 4·5 inch. diam.; light-coloured, rather soft.

Aroo. See Prunus.

29 Artocarpus. Thounben or Thoun-pine, B. fr. Tavoy.

A large tree; used in boat-building. It produces a sort of caout-chouc, with which the Burmese pay their boats.

30 Artocarpus, fr. Tavoy.

A large tree.

31 Artocarpus. Pynyathe or Tanabeng, B. fr. Tavoy.

Wood not used.

32 Artocarpus Chama. Kangtali chama, fr. Gualpara.

The glory of the forests of Gorakpur, where it attains a very great size: used for canoes, for which it is well fitted, being both very buoyant and durable in the water.—*Ham.*

33 Bah-nah-thoa (probably the same as Laurus Panatha of this Catalogue), fr. Tavoy.

Timber 4 to 6 fathoms long; 15 to 24 inches in diameter: used in boat and house-building.

Bajarmandi. See Fagraæa.

Bakhalpani. See Ficus.

Bakuri. See Bauhinia.

Bambusa. Bamboo, fr. Pulo-Geun, in Martaban.

The largest and tallest sort known; the stem 100 feet high, and attaining at the base a diameter of 11 inches, with sides 1 inch thick.

Banatha. See Laurus.

Bancha. See Ligustrum.

34 Bauhinia Tucra. Tukra, fr. Gualpara.

A close-grained, soft, tough wood, of a yellow colour.—*Ham.*

35 Bauhinia Bacuria. Bakuri, fr. Gualpara.

An open-grained, soft, tough wood; 3 cubits in girth: used for furniture.—*Ham.*

36 Bauhinia. Koila, P. fr. Nipal.
The flower-buds are eaten in curries.

37 Bauhinia, fr. Nipal.
A large tree.

38 Berberis pinnatifolia. Milkissee, N.; Jumne-munda, P.; fr. Nipal.
Rarely exceeding a foot in diameter.—Sp. 3 inch. diam.: wood strong, close, compact, yellow.

39 Berberis asiatica. Matekissee, N.; Chitra, P.; fr. Nipal.
Wood small.—Sp. rays rather large, distinct; layers 12 in 1·5 inch.: wood tough, compact, greenish yellow.

Bhela. See Anacardium.

40 Betula leptostachya, fr. Nipal.
Wood not to be distinguished from English birch.—Sp. 2·8 inch. diam.; 3 layers; rays in numerous, straight, narrow, parallel, ribands; bark thin, smooth, spotted like common alder.

41 Betula cylindrostachya, fr. Nipal.
Sp. 4·5 inch. diam.; wood shaky, of no value; layers not distinct enough to be counted; fibre white, glossy; rays dark nut-brown, in very distinct, narrow ribands; bark thick, tubercular.

42 Betula Bhojpattra, N. fr. Nipal.
Sp. 5·8 inch. diam.; about 20 layers; wood moderately hard and compact; cuticle used for writing on, and also for covering the inside of the tube of the hookah and kalioun.

Bhaleo. See Rhus.

43 Bheza Moya. Moj, fr. Gualpara.
A close-grained hard wood.—*Ham.*

Bhoea. See Conyza.

Bhoelasi. See Salix.

Bhongyena. See Decadia.

Bhosee. See Salix.

Bhojpattra. See Betula.

44 Bignonia Colais. Kolai Beng. Parijat, fr. Gualpara.
Often 5 cubits in girth; used only for fire-wood.—*Ham.*

45 Bignonia, fr. the higher parts of the Saluen river in Nipal.

46 Bignonia. Thathee, B. fr. Tavoy.
A very large tree.

47 Bignonia? Thuggainee, B. fr. Tavoy.
A large tree, used in house-building.

48 Bignonia. Lainbha, B. fr. Tavoy.
A middle-sized tree.

49 Bignonia chelonoides, fr. Nipal.
A large tree.

Billae. See Ligustrum.

Bireesee. See Myrsine.

50 Birouni, P. Kurauni, N. fr. Nipal.
Stem 6 to 8 inches in diameter.

Bojhinsi. See Coriaria.

Bonjam. See Gardenia.

Bonkapash. See Hibiscus.

Boro-belock. See Antidesma.

Borogotadhara. See Guarea.

Boropatiya. See Elæocarpus.

Bosuniyapoma. See Guarea.

51 Briedelia stipularis. Kohi, fr. Gualpara.
Grows to a large size; wood close, hard, tough; used for chests, stools, &c.—*Ham.*

52 Briedelia? fr. Nipal.
Wood not very hard, but fine-grained, and fit for ornamental cabinet-work, Sp. 2·5 inch, diam.; colour lighter than box; no tubes nor rays visible.

53 Brucea napalensis, fr. Nipal.

Bukkiamela. See Rhus.

54 Buddleia paniculata. Narum-pattee, P.; Sinna, N.; fr. Nipal.
Sp. 1·6 inch. diam.; rays very indistinct; wood pale brown, dull.

Bukaena. See Melia.

Bulsima. See Symplocos.

Bunamb. See Sphærocaria.

Bunaroo. See Quercus.

Bundhali. See Gardenia.

55 Butea frondosa. Polash, fr. Gualpara.
Sometimes 6 feet in girth; wood open, soft, and tough, but not strong; used in coarse furniture.—*Ham.*

56 Cæsalpinia? fr. Nipal.

57 Cæsalpinia Sappan. Sappan-wood.
A native both of the peninsula of India, of the Burmese country, and of the Malayan Islands. A large and valuable tree; the wood red; used in dying.

58 Calophyllum. Thurappe, B.; Choopee, N.; fr. Martaban.
A large tree, used for masts and spars, and for pestles for oil presses.

59 Calophyllum. Turra-phee, B. fr. Tavoy.
Very different from the preceding; used for masts and spars.

60 Callicarpa arborea. Khoja, fr. Gualpara.
6 feet in girth; used for mortars, pestles, and common furniture.—*Ham.*

61 Calyptranthes. Jam, fr. Gualpara.
8 feet in girth; made into planks, but not considered as of good quality—*Ham.*

62 Calyptranthes. Saljam, fr. Gualpara.
Seldom more than 3 cubits in girth. A close, hard, tough wood, used for posts, beams, and planks.—*Ham.*

63 Camellia Kissi. Kissi, fr. Nipal.
Wood close-grained; no sapwood.—Sp. 1·5 inch. diam.; wood pale brown; bark very thin.

64 Capparis, fr. Nipal.
Sp. 2 inch. diam.; wood white, moderately hard, dull.

65 Capparis, fr. Nipal.

66 Carapa. Taila-oon, B. fr. Tavoy.
Timber 13 to 15 cubits long, 15 to 18 inch. diam.; used in house-building.

67 Careya. Kaza, B. fr. Martaban and Tavoy.
Timber of large size; used for posts and other common purposes.

68 Careya. Kombo, fr. Gualpara.
About 3 cubits in girth; wood close, hard, tough, and strong. Stocks of matchlocks are made of it.—*Ham.*

69 Carpinus viminea. Chukisse, N.; Konikath, B.; fr. Nipal.
Wood esteemed by carpenters.—Sp. pale purplish, with little lustre, hard, rather heavy; tubes small.

70 Cassia Fistula. Sonalu, fr. Gualpara.
6 feet in girth; an open, hard, tough wood, used for ploughs.—*Ham.*

71 Cassia nodosa, fr. Bot. G*.
A very large tree.

* Bot. G., the Company's Botanic Garden at Calcutta.

72 Castanea tribuloides. Cotoor and Chisee; also Makoo Shingali, N. (Shingali, is the general name for oak and chestnut.) Fr. Nipal.

Used for large mortars and pestles for grinding grain in; becomes brown by steeping in water; wood hard and heavy.— Sp. rays like English oak; that is, every 5th or 6th much larger than the others. Another specimen, said to be of the same species, wants the large rays.

73 Castanea martabanica. Nome and Zitha, B. fr. Tavoy.

74 Castanea. Golsinggur, fr. Gualpara.

Branched prickles on the cup of the fruit; leaves entire; timber excellent, close, hard, and tough.—*Ham.*

75 Castanea. Nikari, fr. Gualpara.

Oak or chestnut; cup covered with strong prickles; leaves notched; 5 cubits in girth; timber close, hard, tough; used for furniture and canoes.—*Ham.*

76 Castanea. Kangta Singgur, fr. Gualpara.

Not exceeding 3 feet in girth; inferior in strength and toughness to the preceding.—*Ham.*

77 Cedrela hexandra. Toon-wood, fr. Nipal.

Sp. the wood has a great general resemblance to Laurus; the outer layers have white glossy fibres, with very distinct brown rays; the inner layers are brownish red, harder and more compact; bark with white fibres.

78 Cedrela Toona. Toon or Tungd; Poma; Jeea; fr. Gualpara.

5 cubits in girth; a close, hard, but rather brittle wood, of a brown red colour; very durable, and esteemed for furniture. It has an agreeable smell. —*Ham.* The wood, under the name of Toon, is extensively used among the Europeans in Portugal for chairs and other furniture.

79 Celastrus, fr. Nipal.

An enormous climber.—Sp. trunk deeply channelled externally; wood light, reddish brown; tubes large and numerous; rays deep and very distinct, but of the same colour as the rest of the wood; bark, outer, orange yellow; inner, deep brown.

80 Celastrus verticillata, fr. Nipal.

A small tree.

81 Celastrus ? fr. Nipal.

Sp. 1·8 inch diam.; wood rather soft, very fine-grained; tubes and rays very indistinct; inner bark nearly black; approaches in most of its characters to Turpinia.

82 Celtis australis, fr. Bot. G.

83 Celtis. Khori, P.; Koosikma, N.; fr. Nipal.

84 Cerasus. Puddom. Nipal cherry, fr. Nipal.

Sp. 3·5 inch. diam. 14 layers: rays reddish brown, distinct; wood rather soft, with some lustre.

85 Cerbera Manghas. Kullooa, B. fr. Tavoy.

From the fruit (probably the kernels) an oil is drawn with which the Burmese anoint their hair. Wood not used.

Chacrosila. See Elæocarpus.

Chalita. See Dillenia.

86 Chamærops Martiona, *Wall.* Nipal palm, fr. Nipal.

87 Champa, white, fr. Nipal.

Sp. part of a plank: a free-working wood, soft and light like deal: fibre wavy, white, and very glossy: rays shallow and slender: layers very distinct, 32 in 4·5 inches. Compare Michelia.

Chabsee. See Michelia.

Chasehoo. See Laurus.

Chatiyan. See Alstonia.

Cheriala. See Rhododendron.

Cherouni. See Acer.
Chickooni. See Eurya.
Chillounea. See Gordonia.
Chitra. See Berberis.
Choopee. See Calophyllum.
Choo-kha. See Pongamia.
Choo-mulloo. See Diospyros.
Choo-muna. See Xanthoxylon.
Choopee. See Calophyllum.

88 Choorosi, N. fr. Nipal.

A very fine sort of wood, said to come from the north. I only knew it from having a walking-stick of it, which was presented to me by the Vice-regent of Nipal.

Chose. See Rhus.

89 Chaulmoogra odorata, *Roxb.* fr. Bot. G.

A very large tree.

90 Chotagotadhora, *Bengal,* fr. Gualpara.

Chukisse. See Carpinus.
Chusee. See Elæagnus.

91 Chrysophyllum acuminatum, *Roxb.* Pithogarkh, fr. Gualpara.

3 cubits in girth; wood white, tough, used in furniture.—*Ham.*

92 Chung, fr. Gualpara.

Perhaps a species of Chilmoria. It grows very large, and affords a close tough wood used in furniture.—*Ham.*

93 Cinchona gratissima, *Wall.* Tungnusi, N. and P. fr. Nipal.

A native also of the mountains in Bengal, where it is called Usokuli: used in Nipal for posts and rafters.—Sp. wood brown, light, coarse-grained: bark with many compressed coarse fibres.

94 Clerodendron phlomoides. fr. Bot. G.

95 Coccoloba uvifera, fr. Bot. G.

96 Conyza candicans, *Wall.* Phusrae, P.; Bhoea, N.; fr. Nipal.

97 Cordia Myxa? fr. Nipal.

A large tree.

98 Coriaria nepalensis. Bhojhinsi, N. fr. Nipal.

The fruit is eaten: trunk 4 or 5 inches in diam. Wood not used.

99 Cornus oblonga, *Wall.* Easee, N. and P. fr. Nipal.

A tree of middle size.—Sp. 3 inch. diam. Wood fine-grained, rather hard; fibre white and shining: rays very numerous, reddish brown.

100 Cornus Capitata, *Roxb.* fr. Nipal.

Grows sometimes to a great size. Wood very hard.

101 Corylus ferox, *Wall.* fr. Nipal.

Grows at the top of Sheopore, one of the highest mountains in Nipal; flowers in September, and produces fruit in December: shell of the nut hard and thick. A tree 20 feet high, 2 feet in girth; wood light, compact.

102 Cotoneaster affinis, *Lindl.* fr. Nipal.

103 Cotoneaster obovata, *Wall.* fr. Nipal.

Catoor. See Castanea.

104 Cou-moo, fr. Tavoy.

Timber 5 to 10 fathoms long; 20 to 30 inches in girth; used in boat and house-building; not much inferior to Hopæa.

105 Cratægus arbutiflora. Rooes, N. fr. Nipal.

A small tree, or rather shrub; wood exceedingly strong: used for walking-sticks.

106 Croton oblongifolium, *Roxb.* Parokupi, fr. Gualpara.
5 cubits in girth ; a close-grained but rather brittle wood ; used for coarse furniture.—*Ham.*

107 Croton. Lalpatuja, fr. Gualpara.
3 cubits in girth ; a hard close-grained wood, used for small canoes.

Cusroo. See Quercus.

108 Cyathea spinulosa. Fern-tree, fr. Nipal.

109 Cynometra. Maingga, B. fr. Martaban.
A small tree.

Daine-oksi. See Dillenia.

110 Dalbergia Momsita, *Ham.* Momsita, fr. Gualpara.
Attains a considerable size : wood close, hard, and tough ; used in coarse furniture.—*Ham.*

111 Dalbergia (Rangoon Sissoo), fr. Rangoon, *Ham.*

112 Dalbergia, fr. Nipal.

113 Daphne Gardneri, *Wall.* fr. Nipal.
Wood not used. Bark used for paper stuff.—Sp. 3·75 inch. diam. ; wood light, soft, coarse, of a grey colour, with little lustre ; bark finely fibrous.

114 Daphne cannabina. Loureir, fr. Nipal.
A shrub, from 6 to 8 feet high ; grows on the most exposed parts of the snowy mountains of Nipal. Paper made of the bark is strong, tough, not liable to crack, nor to be eaten by the white ant or other insects.

115 Decadia spicata. Bongyera, fr. Gualpara.
3 cubits in girth. A close, hard, tough wood, used by carpenters.—*Ham.*

Deodae. See Ficus.

Dheyri. See Taxus.

Dhoree. See Gualtheria.

116 Dillenia. Zimboon, B. fr. Tavoy.
Timber 3 to 5 fathoms long, 8 to 10 inches diameter. Wood used in house-building ; it also affords small crooked timbers for boats.

117 Dillenia pilosa, *Roxb.* Daine-oksi, fr. Gualpara.
Trunk 6 feet in girth. Wood open, but hard and tough ; used for canoes. —*Ham.*

118 Dillenia Pentagyna. Oksi, fr. Gualpara.
Wood closer, but in other respects very like the preceding.—*Ham.*

119 Dillenia speciosa. Chalita, fr. Gualpara.
6 feet in girth. Wood close and hard, but rather brittle.

120 Diospyros. Tendoo, N. fr. Nipal.

121 Diospyros ? Ryamucha, B.; Choomulloo, T.; fr. Martaban.
Wood used in house-building.

122 Dipterocarpus grandiflora, *Wall.* Ain or Aintha, B. fr. Martaban, on the banks of the Atran ; also from Tavoy.
A stupendous tree : one of those which yield wood-oil and dammar.

123 Dipterocarpus. Kunnean-phew, B. fr. Tavoy.
5 to 8 fathoms long ; 18 to 24 inches in diameter ; grows to a great size ; used for beams and planks.

Doduan. See Smilax.

124 Dubdubia. (See Rhus.) fr. Nipal.
Sp. 4·2 inch. diam. ; layers 10 ; rays distinct ; tubes few, rather large. Wood very white, light, and soft. Bark thin.

Dudkuri. See Alstonia.

Eandorkomul-soong. See Gardenia.

Earansa. See Eurya.

Easee. See Cornus and Rubus.

Eea. See Loranthus.

125 Ehretia serrata, *Roxb.* Nalshima, N. fr. Nipal; also fr. Gualpara.
5 cubits in girth; gives planks from 12 to 18 inches wide; wood soft and open-grained, but rather tough; not durable; used for posts and other common purposes.

126 Ehretia serrata, or macrophylla. Poegulsee, N. fr. Nipal.
Sp. 3 inch. diam.; layers 10; tubes few and small; rays distinct; wood white, moderately shining, soft.

127 Ehretia lævis, fr. Bot. G.

128 Ekebergia. Jiyakohi, fr. Gualpara.
5 cubits in girth; wood like mahogany, very durable, and much esteemed.

129 Elæagnus, fr. Nipal.
Wood similar to, but whiter than, common hawthorn.—Sp. 4 inch. diam.; layers 27 in 1·7 inch: neither tubes nor rays visible in the cross section: bark thin.

130 Elæagnus. Chusee, N. fr. Nipal.

131 Elæocarpus. Boropatiya, fr. Gualpara.
A close hard wood, of good size, used for canoes.—*Ham.*

132 Elæocarpus Chacrosila, *Ham.* fr. Gualpara.
A close hard wood, used for mortars, chests, &c.—*Ham.*

133 Elæocarpus. Thaumagee, T. fr. Martaban.
Timber very large, used for masts and posts for houses.

134 Embelia, fr. Nipal.
Sp. very imperfect.

135 Eriobotyria elliptica. Mihul, P. and N. fr. Nipal.
Wood cinnamon-brown, hard, compact, and reckoned good.—Sp. 7 inch. diam.; rings indistinct, about 26 in 3·1 inches; tubes very small.

Esealoo. See Rubus.

136 Euonymus. Veysoor, N.; Junghuree, P.; fr. Nipal.
Grows large; wood close-grained, not very hard, perhaps good for carvers.—Sp. rays and tubes scarcely visible: outer bark yellowish gray.

137 Euonymus tingens. Kusoori, N. fr. Nipal.
Wood brown, compact, hard, very fine-grained, dull.—Sp. tubes not visible; rays small and indistinct: bark, outer, orange yellow; inner, brown with fine white fibres: the yellow bark is used for painting the forehead.

138 Euonymus echinata, *Wall.* fr. Nipal.

139 Euonymus pendula (japonica, *Thunb.*), fr. Nipal.
Sp. wood brown, moderately hard, fine-grained dull; tubes and rays as E. tingens: outer bark yellowish in places; inner, brown.

140 Euonymus, fr. Nipal.
Tall, but of a slender stem.

141 Euphorbiacea. Yamala, B. fr. Tavoy.
Wood used for frames of lacquered ware.

142 Eurya nepalensis. Jeegnee, P.; Earansea, N.; fr. Nipal.
A small tree.—Sp. 5 inch. diam.

143 Eurya variabilis (probably the same as the preceding). Chickouni, B. and N. fr. Nipal.
Grows large; wood compact, fine-grained, cinnamon-brown; good for turnery ware.

144 Eurya? fr. Nipal.
Sp. 2·5 inch. diam.: tubes small; rays distinct, red brown; fibre pale brown, with moderate lustre: wood reddish brown, fine-grained, moderately hard.

145 Eurya. Thaun, B. fr. Tavoy.
A small tree, used only for fuel.

146 Excœcaria? Thurrotha, B. fr. Tavoy.

147 Fagara floribunda, fr. Nipal.

Sp. 2·2 inch. diam.: tubes many and large: wood coarse, and of remarkably open grain, but more compact near the axis; colour brownish yellow, nearly dull.

148 Fagara, fr. Nipal.

149 Fagara Rhetza, *Roxb.* Bajarmondi, fr. Gualpara.

Wood close, hard, tough; fit for the joiner.—*Ham.*

150 Fagræa fragrans, *Roxb.* Annah-beng, B. fr. Martaban.

Timber not large; wood yellowish, compact, and beautiful, but very hard, and on this account not much used by the Burmese.

151 Ficus. Doodae-kath, N. P. fr. Nipal.

Ueed for water-courses, drains, and gutters.—Sp. 4·5 inch. diam.; layers 63 in 2 inches; wood soft, free-working, closer than deal; lustre considerable, satiny.

152 Ficus? Kaffræa, P.; Pillaksi, N.; fr. Nipal.

Sp. 1·75 inch. diam.; layers about 50; rays brown, indistinct: wood soft, light, of no use.

153 Ficus, fr. Nipal.

Small specimen; rays distinct; wood soft, light.

154 Ficus, fr. Nipal.

A climber.

155 Ficus, fr. Nipal.

A climber.—Sp. rays nut-brown, strongly marked; wood light, not very soft, pale brown, with some lustre.

156 Ficus, fr. Nipal.

Sp. 4 inch. diam.; rays brown, very distinct; layers very many; wood moderately hard, with some lustre.

157 Ficus, fr. Nipal.

Sp. 2·4 inch. diam.; rays brown, strongly marked; layers very indistinct; tubes large, giving the wood a coarse grain: wood reddish brown, rather hard.

158 Ficus, fr. Nipal.

A large tree.—Sp. 4·5 inch. diam.; layers very numerous; wood soft, worm-eaten.

159 Ficus. Thubboo, B. fr. Tavoy.

A middle-sized tree; wood used in house-carpentry.

160 Ficus. Thuppan, B. fr. Tavoy.

A large tree; wood not used.

161 Ficus undulata. Bakhalpani, fr. Gualpara.

6 cubits in girth; makes good canoes: wood open, soft, rather tough.—*Ham.*

162 Ficus oppositifolia. Khoskadumer, fr. Gualpara.

3 cubits in girth; wood open, soft, brittle.

163 Fraxinus floribunda. Lakkuree, N. fr. Nipal.

Sp. 17 layers in 2·1 inches; in colour, grain, and toughness, just like English ash.

164 Freziera ochnoides, fr. Nipal.

A middle-sized tree; wood pale brown, close-grained, and moderately hard.—Sp. 2·5 inch. diam.; rays hardly distinguishable; resembles pear-tree.

Gambhari. See Gmelina.

165 Garcinia. Pullowa, B. fr. Tavoy.

A large tree, used for posts, &c.

166 Garcinia paniculata, fr. Bot. G.

167 Gardenia florida. Eandorkomul-soang, N. fr. Nipal.

168 Gardenia, fr. Nipal.

Sp. wood cream-brown, fine-grained, hard, compact; probably useful for turnery ware.

169 Gardenia. Bonjam, fr. Gualpara.

3 cubits in girth; well adapted for all kinds of turnery ware.—*Ham.*

170 Gardenia. Bundhali, P. and N. fr. Nipal.

171 Gardenia latifolia, fr. Bot. G.

172 Gardenia lucida, fr. Bot. G.

173 Gastonia palmata, fr. Nipal.

Ghese. See Quercus.

Ghonas. See Rhododendron.

Ghorans. See Rhododendron.

Gillaephul. See Spondias.

174 Gmelina arborea. Gambhari, fr. Gualpara.

Wood light, but durable, does not warp, and is not readily attacked by insects; used for turnery ware of all kinds, and cylinders of a proper size are turned very thin for drums: other musical instruments are also made of it.

Goechassee. See Gordonia.

Golsinggur. See Castanea.

Gomulsee. See Quercus.

Gooki. See Symplocos.

Goonsi. See Podocarpus.

Goopor. See Pyrus.

175 Gordonia integrifolia. Chillounea, P.; Goechassee, N.; fr. Nipal.

The bark contains white spiculæ, that produce violent itching when rubbed on the skin in their recent state. The Burmese have a superstition, that one beam in a house should be made of this wood. Wood brown, nearly dull, moderately hard and compact.

176 Gordonia? Kaza, B. fr. Martaban.

Large timber, used for ordinary building purposes.

Govorpongyata. See Guarea.

177 Grewia. Meaya, B. fr. Tavoy.

178 Gualtheria fragrantissima. Dhoree, N.; Dhoseongree, P.; fr. Nipal.

179 Guarea, fr. Nipal.

Sp. 3·5 inch. diam.; wood moderately hard, compact, pale reddish brown.

180 Guarea. Amari, fr. Gualpara.

5 cubits in girth; wood close, hard, and tough; used for canoes.—*Ham.*

181 Guarea Gobara. Govorpongyata, fr. Gualpara.

Used for canoes.—*Ham.*

182 Guarea Alliaria. Bosuniyapoma, fr. Gualpara,

Used for canoes.—*Ham.*

183 Guarea Gotadhara. Borogotadara, fr. Gualpara.

5 feet in girth; wood close and hard; used by joiners.—*Ham.*

Guarnasi. See Rhus.

Hakoolual. See Limonia.

Harobaer. See Ziziphus.

184 Heritiera Fomes, *Ham.* (minor, *Roxb.*) Kunnazoo, B. fr. Tavoy, Soondree of Bengal.

A very large tree; wood exceedingly hard and durable; used for pestles for oil-mills; shafts of gigs, spokes, and naves, are made of it: an excellent fuel for burning bricks; grows to a much greater size on the Martaban coast than in Bengal.

185 Hibiscus macrophyllus, *Roxb.* fr. Tavoy.
A middle-sized tree, used for common building purposes, bark tough and stringy; is made into cordage.

186 Hibiscus (perhaps a Sterculia), fr. Tavoy.
Applied to the same uses as the foregoing.

187 Hibiscus Lampas. Bonkapash, fr. Gualpara.
6 feet in girth; a soft, open wood, used for coarse furniture.—*Ham.*

188 Holboellia (Stauntonia) latifolia. Bagul, T. fr. Nipal.
A vast climber.

189 Hopea odorata. Tengaun or Thaengong. Common on the Tenasserim and Martaban coasts.
Canoes are made of this tree, which grows to an enormous size: it also produces a valuable resin or dammar.

190 Hopea floribunda, *Wall.* Tantheya, fr. Tavoy.
A very large tree.

191 Hovenia dulcis, fr. Nipal.
A very large tree.—Sp. 3 inch. diam.; layers 9; wood light, coarse-grained.

192 Hydrangea altissima, fr. Nipal.
A climber.

193 Hydrangea trigyna, *Wall.* fr. Nipal.

194 Hymenodictyon flaccidum, *Roxb.* fr. Nipal.
Sp. 1·125 inch. diam.; wood dirty grey, nearly dull; moderately hard.

195 Ilex dipyrena, *Wall.* Karaput, P.; Munasi and Gulsima, N.; fr. Nipal.
Wood heavy, hard, fine-grained, and much like common holly, said to become black with age; used for various purposes of carpentry.—Sp. 3 inch. diam.; tubes very small; rays distinct.

196 Jambolifera pedunculata. Hulhholi, fr. Gualpara.
3 cubits in girth; used for stocks of matchlocks.—*Ham.*

197 Jasminum arboreum. Anjoo, N. from Nipal.
Sp. 4 inch. diam.; wood pale brown, nearly dull, fine-grained, hard, compact.

198 Jasminum dispermum, fr. Nipal.

199 Jasminum chrysanthum. *Roxb.* fr. Nipal.
Sp. 1·8 inch. diam.; neither tubes nor rays visible; wood white, fine-grained, moderately hard; brittle, hard concretions in the bark.

Jeea. See Cedrela.

Jeegue. See Eurya.

Jhoori. See Osyris.

Jiyakoki. See Ekebergia.

Joolchumahl. See Acacia.

200 Joolshima, N. fr. Nipal.

Juggoochal. See Andromeda.

201 Juglans pterococca, *Roxb.* from Nipal.
An exceeding large tree.—Sp. 3·5 inch. diam.; wood pale reddish brown, with considerable lustre, but rather coarse-grained.

Julsi. See Rondeletia.

Jumnemandoo. See Berberis.

Junghurree. See Euonymus.

202 Juniperus excelsa, Bieb? The Cedar of Himalaya.
Harder and less odorant than the West Indian cedar; an excellent light wood.

203 Justicia Adhatoda. Kath, P.; Alesi, N.; fr. Nipal.

204 Kaantha, B. fr. Tavoy.

3 to 5 fathoms long, 12 to 15 inches in diameter. Yields a small but valuable timber for oars and paddles.

Kadabusi. See Ziziphus.

Kaffræa. See Ficus.

Kaintha-phogee. See Symplocos.

Kaizai. See Laurus.

205 Kalajiya, fr. Gualpara.

Common over all India; remarkable for the facility with which it grows from cuttings, and from truncheons; yields much gum; wood of no use.—*Ham.*

Kalikat. See Limonia.

Kalikath. See Symplocos.

Kalikaut. See Myrsine.

Kanaput. See Ilex.

Kangtali-chama. See Artocarpus.

Kangta-singgur. See Castanea.

Kath. See Justicia.

206 Kaunzo-Kurro, B. fr. Tavoy.

5 to 7 fath. long, 15 to 20 inch. diam.; used in boat-building. *See also* Meliacea.

Kayzai. See Laurus.

Kaza. See Careya and Gordonia.

207 Keahnaun, B. fr. Tavoy.

15 to 20 feet long, 15 to 20 inch. diam.; strong crooked timber, used for musket-stocks. *See also* Xylocarpus.

Keannan. See Xylocarpus.

Kee-tha. See Syndesmis.

Keounlak. See Rottlera.

Keysoor. See Euonymus.

Kheemna. See Laurus.

208 Kheera, N. fr. Nipal.

An Euphorbiaceous tree, of no value.

Khori. See Celtis.

Khoskadumor. See Ficus.

Koila. See Bauhinia.

Kohi. See Briedelia.

Kolai. See Bignonia.

Kombo. See Careya.

Komkath. See Carpinus.

Kongeea. See Rondeletia.

Korui. See Acacia.

Kooathoe. See Myristica.

Koosikma. See Celtis.

209 Kuddoot-Alain, B. fr. Tavoy.

Grows to a great size; used by house and boat-builders.

210 Kuddoot-nee, B. fr. Tavoy.

6 to 8 fath. long, 15 to 20 inch. diam.; an inferior wood, used in boat-building.

Kuenmoonee. See Lagerstroemia.

211 Kujulsee, P. and N. fr. Nipal.

Trunk 2 feet in diam.; wood strong and durable; used for door-posts.

Kullooa. See Cerbera.
Kullowa. See Laurus.
212 Kummi, B. fr. Tavoy.
Kunna. See Pierardia.
Kunnazoo. See Heritiera.
Kunnean-phew. See Dipterocarpus.
Kunneen. See Myristica.
Kunneen-keunke. } See Symplocos.
Kunneen-keunla. }
Kunneenee. See Sterculia.
Kurauni. See Birouni.
Kurrowa. See Laurus.
Kusoori. See Euonymus.
Kuzzo. See Pierardia.
Kyakle. See Quercus.
Kyamucha. See Diospyros.
Labtesee. See Panax and Rottlera.
213 Lagerstroemia. Kuenmounee or Peema, B. fr. Tavoy.
Used in house-building, and for oars.
214 Lagerstroemia parviflora, *Roxb.* Sida, fr. Gualpara.
A large tree, 6 feet in girth, and very common; wood close, hard, and tough, forming excellent timber.—*Ham.*
215 Lagerstroemia Reginæ. Jarul, fr. Gualpara.
6 feet in girth, used in boat-building; but the wood is soft, and deficient in toughness.—*Ham.* It is extensively used in Bengal under the name of Jarul.—*Wall.*
Lakhurree. See Fraxinus.
Lalpatuja. See Croton.
Lambha. See Bignonia.
Langchi. See Aquilaria.
Latasishnoo. See Urtica.
216 Laurina. Tapahaw, N. fr. Nipal.
217 Laurus. Lumpatch, P.; Chasepoo, N.; fr. Nipal.
4 to 6 feet in diam.; wood soft and pale when young, hard and pale red when older; used in carpenter's work, and for beams.—Sp. 27 layers in 1·8 inches; lustre considerable; rays mostly distinct.
218 Laurus glandulifera. Sassafras and Camphor-wood of Nipal, fr. Nipal.
Sp. fibre pale flesh colour, with considerable lustre; rays small, dark red-brown; wood soft, coarse.
219 Laurus. Very like the preceding. Kullowa or Kurrowa, B. fr. Tavoy.
Produces the sassafras-bark and camphor-wood of Martaban.
220 Laurus caudata, fr. Nipal.
Sp. fibre light-coloured, shining; tubes not numerous but large; rays distinct, dark brown; 4·2 inch. diam.; layers 12; axis very eccentric.
221 Laurus albiflora, fr. Nipal.
A large tree.—Sp. 3·8 inch. diam.; fibre, tubes, and rays, as the foregoing.
222 Laurus. Panatha (Banatha ?), B. fr. Tavoy.
Used in house carpentry.

223 Laurus. Maythen, B. fr. Tavoy.
5 to 6 fath. long, 18 to 26 inch. diam.; a very large tree; wood used for furniture, in house carpentry, and for planks and upper decks for proas.

224 Laurus. Pahela, N. fr. Nipal.

225 Laurus? Kheemna, B. fr. Tavoy.
Timber small; used for posts and rafters.

226 Laurus. Phetpetta, N.; Balukshee, P.; fr. Nipal.
Wood red-brown, of a fine grain, used for chests, &c.—Sp. fibre and rays as other Lauri; tubes filled with a dark red-brown substance.

227 Laurus. Chausoma, N. fr. Nipal.
Sp. fibre light-coloured, with considerable lustre; tubes rather large; rays distinct, dark-brown.

228 Laurus. Sami-lumpata, P.; Chikihul-tussipoo, N.; fr. Nipal.
Sp. fibre cream-colour, shining; tubes and rays cinnamon-brown; rather fine grain.

229 Laurus. Keebula, N.; Kalechampoo, P.; fr. Nipal.
Sp. 3·2 inch. diam.; fibre, tubes, and rays, as other Lauri.

230 Laurus. Pumlasi, N.; Khorkula, P.; fr. Nipal.
A large tree; wood strong and durable.—Sp. 1·6 inch. diam.

231 Laurus. Khulsi, N. fr. Nipal.

232 Laurus (or Tetranthera), very like T. pulcherrima. Bulooksee, N.; Sengoulee and Tijpaut, P.; fr. Nipal.
Wood excellent, used for spinning wheels.—Sp. 3·5 inch. diam.; fibre, tubes, and rays, as other Lauri.

233 Laurus. Phusree, N. and P. fr. Nipal.
Wood grayish brown.

234 Laurus lanuginosa, *Wall.* fr. Nipal.
Sp. wood cream-brown; moderately hard; rays, tubes, and fibre, as others.

235 Laurus. Thuggoo, B. fr. Tavoy.
4 to 6 fath. long, 12 to 18 inch. diam.; used for oars and rudders.

236 Laurus, (Tetranthera bifaria, *Wall.*) Juttrunga, N.; Pahelakath, P.; fr. Nipal.
Large and useful timber; wood soft, rather spongy.—Sp. 6 inch. diam.; rotten at heart; fibre pale yellow, glossy; rays distinct, dirty brown.

237 Laurus? Thitya, B. fr. Tavoy.
A very large tree; wood used for house-building, and for mortars in which rice is husked.

238 Laurus. Kayzai, B. fr. Tavoy.
Wood used in house carpentry.

239 Laurus salicifolia. Horisongher, fr. Gualpara.
6 feet in girth; wood has a strong smell of camphor; used for coarse articles of furnitnre.—*Ham.*

240 Laurus Champa. Kurka-champa, fr. Gualpara.
3 cubits in girth; used for coarse furniture.—*Ham.*

241 Leucosceptrum, fr. Nipal.
Wood used for rafters; soft and of no value.—Sp. fibre with some lustre; rays moderately distinct; axis very eccentric.

242 Leycesteria formosa, *Wall.* fr. Nipal.

243 Ligustrum napalense. Billae or Bancha, N. and P. fr. Nipal.
Timber about a foot or more in diameter; used for building purposes.—Sp. 4 inch. diam.; layers about 10 in an inch: wood heavy, hard, compact, tough, and very fine-grained; for the purposes of the engraver will probably be found nearly as good as Mediterranean box; bark with coarse white fibres.

244 Limonia. Kailkat, P.; Hakoolnal, N.; fr. Nipal.
Timber large for the genus; wood white, soft, but close, strong, and tough; fit for fine turnery ware.—Sp. 7 inch. diam.; neither rays nor tubes visible; inner bark very fibrous.
245 Limonia crenulata, fr. Nipal.
Wood yellow, very hard; used in house-building.
Lissokatta. See Loranthus.
Lolsi. See Taxus.
246 Loranthus. Eea, N.; Lissokatta, P.; fr. Nipal.
Loshima. See Viburnum.
247 Ludia. Mulloka, N.; Antheel; fr. Nipal.
Used for posts and walking-sticks.
248 Ludia spinosa, fr. Bot. G.
Lumpatch. See Laurus.
Lushpoo. See Sphærocaria.
Luzun. See Pongamia.
249 Magnolia insignis, *Wall.* fr. Nipal.
Sp. 3 inch. diam.; 12 layers; wood rather soft, moderately fine-grained, and with some lustre.
250 Mainaban, B. fr. Tavoy.
Resembles lance-wood; used for beams, posts, and rafters; also for lances, bows, sword-handles, &c.
Maingga. See Cynometra.
Magor. See Vernonia.
Mako-shingali. See Castanea.
Makusal. See Gordonia.
251 Malpighia lucida, fr. Bot. G. A native of America.
Masoochi. See Laurus.
252 May-chin-chan-jay. Probably a species of Ebenus.
253 May-klen, fr. Tavoy.
Scarce and dear; used for rudders and anchors.
254 May-maka, fr.
Used for timbers of junks.
255 May-rang, fr. Tavoy.
Said to be very durable, and much esteemed for the posts of houses built on the bank of rivers.
256 May-tobek, fr. Tavoy.
Imported in long planks, and used in preference to teak for the bottom planks of ships.
Mathen. See Laurus.
Meaya. See Grewia.
257 Meenaban, fr. Martaban.
5 to 8 cubits long, 6 to 10 inch. diam.; a durable and pliant wood, used for sword-handles and spear-shafts.
258 Megeongee, fr. Tavoy.
A very large tree, used in house-building.
Mehul. See Pyrus.
259 Melia. Bukaena, P.; Baksi, N.; fr. Nipal.
260 Meliacea? Kanzo-Kurroo, B. fr. Nipal.
261 Meliacea. Tokor, fr. Gualpara.
A large tree, used for planks, canoes, and coarse furniture.—*Ham.*
262 Menispermum laurifolium, *Roxb.* fr. Nipal.
A large tree, very remarkable for the grain and irregular layers of its wood.

Mhasoosee. See Spondias.

263 Michelia Kisopa, *De Cand.* Champ or Chaump, P.; Chobsse, N.

The wood much used for light works.—Sp. piece of a plank, 30 layers in 3·75 inches; another Sp. 2·5 inch. diam. 12 layers in 1·1 inch. Similar to white Champa, No. 87, but the colour is more yellow, and the rays less distinct.

Mihul. See Eriobotrya.

Mikay. See Murraya.

Milkissee. See Berberis.

264 Millingtonia pungens, fr. Nipal.

A middle-sized tree.

265 Mimosa capensis, Bot. G.

266 Mimosa odoratissima, Bot. G.

267 Mimosa polystachya, Bot. G.

268 Minusops. Thubbae, B. fr. Tavoy.

Wood used for masts and spars; affords also good crooked wood.

269 Minusops Elengi, fr. Tavoy.

Slow-growing; reared only on account of its flowers, which smell like Russia leather.

270 Mimusops? Chalpata, fr. Gualpara.

A tree of moderate size, used for coarse furniture.—*Ham.*

Moj. See Bheze.

Momsita. See Dalbergia.

271 Morinda citrifolia, Bot. G.

The root yields a yellow dye.

272 Morus lævigata, *Wall.* fr. Nipal.

A large tree.—Sp. 1·5 inch, diam.; wood coarse brownish yellow, with considerable lustre.

273 Morus mauritiana, fr. Bot. G.

Motikissee. See Berberis.

Moyen. See Vauqueria.

274 Mucuna, fr. Nipal.

A superb climber (a kind of cowhage).

Mullokath. See Ludia.

Munasi. See Ilex.

Munachoo. See Rottlera.

275 Murraya. Maikay, B. fr. Tavoy.

4 to 5 feet long, 3 to 6 inch. diam.; used for handles of daggers and of other weapons. A strong, tough wood, in grain like box.

276 Myginda. Silapoma, fr. Gualpara.

5 cubits in girth; used for coarse furniture.—*Ham.*

277 Myrica sapida, *Wall.*; Kaephul, P.; Kobusi, N.; fr. Nipal.

Grain like birch, but the colour darker.—Sp. 2·5 inch. diam.; fibre brownish white, nearly dull; rays very distinct, dark brown in the outer layers; the interior layers harder, heavier, and more compact. The fruit is eaten.

278 Myristica? Thounsanga, B. fr. Tavoy.

A large tree; the wood used in boat-building.

279 Myristica. Koathoe or Kunneen, B. fr. Tavoy.

A large tree; the wood used for flooring houses: perhaps the same as the foregoing.

280 Myristica. Jheruya, fr. Gualpara.

A sort of nutmeg, but neither the nut nor mace have any aroma: timber 5 cubits in girth, used for furniture.—*Ham.*

281 Myrsine capitellata, fr. Nipal.
Wood compact, hard, with a handsome grain.—Sp. 3·5 inch. diam.; fibre cream-colour; rays very distinct, broad, heavy, pale brown.

282 Myrsine semiserrata. Bireesee and Kalikaut, N. and P. fr. Nipal.
Wood excellent.—Sp. 2·5 inch. diam.; rays large, deep flesh-colour, and very ornamental.

283 Nauclea Cadamba, *Roxb.* Kodom, fr. Gualpara.
A noble tree, 6 feet in girth; wood yellow, used for coarse furniture.—*Ham.*

284 Nauclea undulata, fr. Bot. G.

Nalshima. See Ehretia.

285 Nerium tomentosum. Adhkuri, fr. Gualpara.
3 cubits in girth; used for furniture.—*Ham.*

286 Nerium antidysentericum. Dudkhuri, fr. Gualpara.
Of the same size and uses as the foregoing: beads are also made of it.—*Ham.*

287 Nikari, fr. Gualpara.
An oak or chesnut; cup covered with large prickles; leaves notched; 5 cubits in girth; used for canoes and furniture.—*Ham.*

Niyor. See Schinus.

Nome. See Castanea.

Novum-pattee. See Buddleia.

Odla. See Sterculia.

Okchi. See Dillenia.

288 Olea glandulifera, fr. Nipal.
A large tree.—Sp. 5 inch. diam.; rays very thin and indistinct; wood pale brown, very hard, heavy, and compact.

289 Oleina, fr. Nipal.
A middle-sized tree.—Sp. 3 inch. diam.; wood pale brown, with considerable lustre, handsome grain, and very hard.

Oosihu. See Podalyria.

290 Ormosia glauca.
Sp. 3·5 inch. diam.; wood light brownish yellow, with some lustre, hard, and coarse-grained.

291 Osyris napalensis. Ihoori, P. and N. fr. Nipal.
A large timber tree, the fruit of which is eaten, and the wood is in estimation.—Sp. 1·5 inch. diam.; tubes very small; wood red-brown, rather hard, compact, and very fine-grained.

292 Osyris peltata. Phaoun, B. fr. Tavoy.

Pahela. See Laurus.

Paingodoo. See Acacia.

Palash. See Butea.

Paluepean. See Sapota.

Panatha. See Laurus.

293 Panax polyacanthus, fr. Nipal.
A large tree.

294 Panax. Lubtesee, N. fr. Nipal.
Sp. about 2·5 inch. diam.; wood soft, light, spongy, with high lustre; bark with short thick tubercles or spines, broad at the base.

295 Panax? fr. Nipal.
Sp. 4 inch. diam.; wood soft, light, spongy, nearly dull; rays numerous, and very distinct in the outer layers.

296 Panax, fr. Nipal.

297 Panax pendulus, fr. Nipal.
A middle-sized tree; wood pale reddish brown, light, moderately hard; rays distinct, giving a handsome grain.
Pangeh-petiya. See Tetranthera.
Panmuja. See Tetranthera.
Parijat. See Bignonia.
Paro-kupi. See Croton.
Passy. See Pyrus.
Paunlah. See Symplocos.
Peema. See Lagerstroemia.
298 Penlay-peen, fr. Tavoy.
5 to 6 fathoms long; 8 to 15 inches diameter; used in house-building.
Phaoun. See Osyris.
299 Photinia dubia, *Lindl.* fr. Nipal.
Grows about 20 feet high; wood hard, fine-grained.
300 Photinia integrifolia, fr. Nipal.
Sp. 2·1 inch. diam.: works freely; somewhat coarse; colour reddish brown, with scarcely any lustre.
Phrarat. See Quercus.
Phurasee. See Turpinia.
Phusrae. See Conyza.
Phutki. See Eurya.
301 Phyllanthus Emblica, fr. Nipal.
Sp. 3 inch. diam.; layers about 8, very indistinct; rays distinct: a handsome, nut-brown, glossy, hard wood.
302 Phyllanthus? Horinhara, fr. Gualpara.
A tree of moderate size; the wood used for coarse furniture.—*Ham.*
303 Pienmahne, fr. Tavoy.
4 to 6 fathoms long; 18 to 20 inches diameter; affords the best and strongest crooked timber, and is very durable; used also in house-building.
304 Pienmah-pue, fr. Tavoy.
*See* Lagerstroemia.
305 Pierardia? Kunna or Kuzzo, B. fr. Tavoy.
Pillaksi. See Ficus.
306 Pinus excelsa, fr. Nipal.
Wood remarkably compact.—Sp. 3 inch. diam.; 6 layers.
307 Pinus longifolia, fr. Nipal.
Excellent timber, like Memel deal.
308 Pinus Brunoniana, fr. Nipal.
Wood soft, and of no value.
309 Pinus Webbiana, fr. Nipal.
Sp. 7 inch. diam.; exterior layers soft, and of no value; interior ones harder and finer-grained.
310 Pinus Dammara? fr. Tavoy.
A very large tree; used for beams and rafters.
311 Pinus Deodara. Himalaya Cedar, fr. Nipal.
Wood very fragrant.
Pithogarkh. See Chrysophyllum.
312 Plumeria alba, fr. Bot. G.
A West Indian tree.
313 Plumeria acuminata, fr. Bot. G.
A West Indian tree. Every part, both of this and of the foregoing, full of milky juice.

314 Podalyria napalensis. Potugalla, N.; Oosihu, P.; fr. Nipal.

315 Podocarpus macrophylla. Goonsi, N. fr. Nipal.

The peduncle of the fruit, but not the fruit itself, is eaten.

316 Polygonum. Tuknee, P.; Tauntul, N.: fr. Nipal.

Used only for fire-wood. The young shoots have a pleasant acidulous taste, and are eaten.

317 Polypodium giganteum. A tree-fern, fr. Nipal.

A stem, 45 feet in height, and proportionately thick, was presented by the Directors of the East India Company to the British Museum.

Poma. See Cedrela.

318 Pongamia atropurpurea, *Wall.* Lazun, B.; Choo-kha, T.: fr. Martaban.

A noble forest-tree; native of environs of Amherst and Moulmein, on the Martaban coast: the wood used in boat and house building; flower of a dark purple colour.

Popeeah. See Acacia.

Potugalla. See Podalyria.

319 Premna spinosa, fr. Bot. G.

320 Premna. Toomulse, N. fr. Nipal.

321 Premna hirsina. Chikagambhari, fr. Gualpara.

Is often found 6 feet in girth; the wood has a strong odour like the musk rat; it is used for making musical instruments, and for other uses. It is said that no insect will eat it.—*Ham.*

322 Premna flavescens. Bukdholi, fr. Gualpara.

3 cubits in girth; wood very inferior to the foregoing.—*Ham.*

Pregulsee. See Ehretia.

323 Prunus glaucifolia. Ranipeeplee, N. fr. Nipal.

A large tree.

324 Prunus adenophylla. Aroo, P. fr. Nipal.

A large tree.—Sp. 2·5 inch. diam.; fibre white and glossy; rays brown, distinct; tubes rather small; wood light and soft, but harder and reddish brown near the centre.

325 Prunus ferruginea, fr. Nipal.

326 Psychotria rotata, fr. Nipal.

Sp. 3·5 inch. diam.; axis very eccentric; wood pale reddish brown, dull, fine-grained, moderately hard.

327 Pterocarpus? Puddow, B. fr. Tavoy.

A large tree; wood used for furniture and musical instruments.

328 Pterocarpus? Thoun-kheea, B. fr. the river Attran, in Martaban.

Puddow. See Pterocarpus.

Pullowa. See Garcinia.

Puzzeen-zwa. See Ternstroemia.

Pynathe. See Artocarpus.

329 Pyrus indica, *Roxb.?* Mehul, P.; Passi, N.; fr. Nipal.

Sp. 2·5 inch. diam. wood brown, compact, moderately hard, very fine-grained; tubes exceedingly small; bark very thin, composed of 9 brown layers alternating with as many white ones; the thickness of the whole scarcely ⅛ of an inch.

330 Pyrus vestita. Goohor, N. fr. Nipal.

Sp. 3·6 inch. diam.; about 20 layers; wood soft, compact, of a pale colour, nearly dull.

331 Pyrus foliolosa, fr. Nipal.

A climber.—Sp. 2·5 inch. diam.; wood pale brown, fine-grained, nearly dull, moderately hard.

332 Pyrus ursina, fr. Nipal.

333 Quercus spicata, fr. Nipal.

A very large tree; wood very like English oak; every 7th or 8th ray much thicker than the others.

334 Quercus semecarpifolia. Ghese and Cusroo, N. fr. Nipal.

A very large tree, from 14 to 18 feet in girth, at 5 feet above the ground; clear trunk from 80 to 100 feet.—Sp. 3·5 layers in 2·4 inches; wood light pale brown; rays small, uniform.

335 Quercus lamellosa. Shulshee and Phrarat, N. fr. Nipal.

Wood very hard, straight-grained, and good, of a pale brown colour; rays uniform.

336 Quercus. Bunaroo, P.; Gomulsee, N. fr. Nipal.

Wood soft, works as easily as deal; fibre grey, with considerable lustre; rays uniform, reddish brown, very distinct; layers indistinct; heart reddish brown.

337 Quercus lanata, fr. Nipal.

A very large tree.—Sp. bad.

338 Quercus lamellata, fr. Nipal.

339 Quercus polyantha, *Lindl.* Soosi-Singhali, N. fr. Nipal.

340 Quercus. Tima, fr. Gualpara.

Leaves entire; acorns covered entirely by an unarmed cup formed of concentric rings; timber not more than 3 cubits in girth; used for coarse furniture.—*Ham.*

341 Quercus Amherstiana, *Wall.* Tirbbae, B.; Ryakle, T.; fr. Martaban.

Grows to a large size; wood used in boat-building, &c.

342 Quercus, from the mountains called Taong-Dong, near Ava.

Ranipeeplee. See Prunus.

343 Rhamnea, fr. Nipal.

A large climber.—Sp. 1·8 inch. diam.; heart moderately compact; outer part coarse-grained, rather hard.

344 Rhamnea. Bungla, fr. Gualpara.

5 cubits in girth; used for chests, stools, and other coarse furniture.

345 Rhamnus (Premna?) Gondsori, fr. Gualpara.

5 cubits in girth; used for canoes and chests.

346 Rhamnus virgatus, fr. Nipal.

Wood very hard and heavy; the heart a bright-red brown, not unlike English yew.—Sp. 3·5 inch. diam.; tubes very irregular; rays scarcely visible.

347 Rhododendron arboreum. Ghorans or Ghonas, P.; Tuggoo, N.; fr. Nipal.

The wood resembles plum-tree; used for gun-stocks.

348 Rhododendron arboreum (white-flowered variety). Teuggoo Tuggoo (Teuggo means white), N.; Saphed Gonos or Ghorons, P.; fr. Nipal.

Grows to a large size.—Sp. 6 inch. diam.; wood rather hard, pale brown; rays in the outer layers very distinct; tubes few and large; layers indistinct.

349 Rhododendron campanulatum. Cheriala, P.; Teotosa, N.; fr. Nipal.

A large tree.—Sp. 3·1 inch. diam.; 26 layers, very distinct; rays indistinct: tubes hardly visible.

350 Rhus Bukkiamela, *Roxb.* Subuchunsee, N.; Bukkiamela, P.; fr. Nipal.

Timber good and large.—Sp. 3·5 inch. diam.; greyish white, with considerable lustre; soft, light.

351 Rhus? Dubdubea? P.; Guarnusi, N.; fr. Nipal.
Sp. 3 inch. diam.; layers about 10: fibre light cream-colour, with high lustre; rays distinct, reddish brown; wood very light and soft; bark thin.

352 Rhus succedaneum, fr. Nipal.
A large tree.

353 Rhus juglandifolium, *Wall.* Chose, N.; Bhalaeo, P.; fr. Nipal.
Very like the Japan varnish-tree.—Sp. 3·5 inch. diam.; heart red-brown, the tubes being filled with a substance of this colour; wood soft, bears a considerable resemblance to the Lauri, with indistinct rays.

354 Rondeletia cana, *Wall.* fr. Nipal.

355 Rondeletia coriacea, *Wall.* Kongeea, P.; Julsi, N.; fr. Nipal.
Wood close-grained, and becomes of the colour of mahogany some time after it has been cut; layers very indistinct: used for rafters, tools, &c. A red dye is also prepared from it.

356 Rosa macrophylla, *Lindl.* fr. Gossain-Than, in the Himalaya.

357 Rottlera. Teeta-kath, N.; Labtesee, P.; fr. Nipal.

358 Rottlera (perhaps tinctoria), fr. Nipal.
Wood pale brown, compact, hard, fine-grained; bark very thin.

359 Rottlera tinctoria, fr. Nipal.
Fruit used as a red dye.

360 Rottlera arborea, fr. Nipal.
Wood light, coarse, soft, worm-eaten: inner bark stringy.

361 Rottlera? Keoun-lae, B. fr. Tavoy.
A large tree; wood used for rudders, &c.

362 Rottlera. Memasho, B. fr. Tavoy.

363 Rubus Gouriphul. R. ellipticus, *Sm.* Escallo, P.; Eesi, N.; fr. Nipal.
Common in hedges; as thick as a stout arm; fruit eatable.

364 Sabia parviflora. Mhasoosee, P. and N. fr. Nipal.
Bark spongy, of a yellow colour; sometimes used for marking the forehead.

365 Salix. Bhoelasi, P. and N. fr. Nipal.
A small tree, not more than 8 or 10 inches in diameter.

366 Salix babylonica. Tissee and Bhosee, N. and P. fr. Nipal.
Attains an enormous size.

367 Salix, fr. Nipal.

Saljam. See Calyptranthus.

368 Sandoricum. Thittoo, B. fr. Tavoy.
Wood used for furniture.

Saora. See Trophis.

Saphed-gonos. See Rhododendron.

Saphew. See Xanthoxylon.

369 Sapindacea. Dophari, fr. Gualpara.
A small tree; used for coarse furniture.—*Ham.*

370 Sapotea? Palaepean, B. fr. Tavoy.
Leaves most beautifully silky and gold colour beneath. A very large tree; wood used in building.

Saul or Sâl. See Shorea.

371 Schinus Niara, *Ham.* Niyor, fr. Gualpara.
5 cubits in girth; a hard, close-grained rather brittle wood, with a resinous scent; preferred by the natives to almost any other for furniture.—*Ham.*

372 Schoepfia fragrans, fr. Nipal.
Sp. 2·5 inch. diam.; a coarse, light, soft wood.

373 Scytalia Longan, Bot. G.

374 Scytalia Litchi, Bot. G.

375 Securidaca reniformis, fr. Nipal.

Sp. a soft white wood; rays of the same colour as the fibre.

Seesaong. See Aralia.

376 Semecarpus Anacardium. Marking-nut, fr.

Wood soft, and full of acrid juice; not used.

377 Shorea robusta. Saul or Sâl.

This is the staple timber of Hindostan for building purposes: vast quantities of dammar, or resin, are extracted from it, as well as from Dipterocarpus and Hopea, all of which belong to one family, the Dipterocarpeæ.

Sida. See Lagerstroemia.

Signa. See Turpinia.

Silapoma. See Myginda.

Sinna. See Budlæa.

Sissoo. See Dalbergia.

378 Smilax. Doduan, P. and N. fr. Nipal.

Sonalu. See Cassia.

379 Sonneratia? Thaumma, B. fr. Tavoy.

A small tree.

380 Sonneratia apetala, Bot. G.

Soosi-Singhali. See Quercus.

381 Sphærocaria edulis. Bun-amb, P.; Lushpoo, Ael, or Ealmarisee, N.; fr. Nipal.

Used for posts and for fire-wood.—Sp. the wood has a handsome grain, like Sycamore, but with scarce any lustre: rays very distinct, of the same yellowish grey colour as the fibre.

382 Sphærosacme fragrans, fr. Nipal.

A coarse, rather soft, dusky-coloured wood, without lustre.

383 Spondias axillaris. Lupshe, N. fr. Nipal.

Sp. 2·8 inch. diam.; layers about 11; fibre white, with considerable lustre; rays moderately distinct; tubes rather large.

384 Spondias. Sillaephul, N. fr. Nipal.

385 Spondias acuminata, Bot. G.

A large tree.

386 Spondias Amara. Amra, fr. Gualpara,

Grows to a good size, but is not made use of.—*Ham.*

387 Sterculia? Kuneenee, B. fr. Tavoy.

Attains an enormous size. An oil is extracted from the wood by incision, which is used for torches.

388 Sterculia. Thikadoo, fr. Tavoy.

389 Sterculia angustifolia, fr. Bot. G.

390 Sterculia. Bahelli, fr. Gualpara.

5 cubits in girth; used for canoes.—*Ham.*

391 Sterculia urens. Odla or Hatchanda, fr. Gualpara.

5 cubits in girth; used for canoes. A coarse rope is made from the bark, which is used in taking wild elephants.—*Ham.*

392 Stravadium acutangulum. Hendol, fr. Gualpara.

3 cubits in diameter; the wood much used, but neither strong nor handsome.—*Ham.*

Subuchunsee. See Rhus.

Suslendi. See Acer.

393 Syndesmis Tavoyana, *Wall.* Kee-tha, B.; red-wood; fr. Tavoy.

A very large tree; used in building, and for boxes, &c.

394 Symplocos. Gooki, N. fr. Nipal.
A tall, slender tree; wood not esteemed. Most of this genus produce a yellow dye.

395 Symplocos floribunda, fr. Nipal.
A large tree; wood fine-grained.

396 Symplocos? Kalikath, P.; Paunlah, N.; fr. Nipal.
A large tree.—Sp. wood white, compact, of a very fine-grain, and as soft as deal; no tubes visible; rays indistinct; bark as thin as paper.

397 Symplocos. Bulsima, fr. Nipal.

398 Symplocos? fr. Nipal.
A large tree.—Sp. 3 inch. diam.; wood cream-brown, moderately hard.

399 Symplocos pulcherrima, fr. Nipal.
A small tree.

400 Symplocos lucida, fr. Nipal.
Sp. 3 inch. diam.; rays indistinct; wood rather hard, very fine-grained, with little lustre.

401 Symplocos? Kain-tha-phogee, B. fr. Tavoy.
13 to 17 feet long, 6 to 12 inch. diam.; used for posts and oars; affords good but small crooked timber.

402 Symplocos. Kunneen-keunkee or Kunneen-keunla, B. fr. Tavoy,
Used for beams, posts, &c.

Taila-oon. See Carapa.

Tantheya. See Hopea.

403 Tantheya, B. fr. Tavoy.

Tapahaw. See Laurina.

404 Tanguet nee, fr. Tavoy.
6 to 8 fathoms long, 15 to 20 inch. diam. Does not saw kindly.

Tauntul. See Polygonum.

405 Taxus virgata, *Wall.* Dheyri, P.; Lolsi, N.; fr. Nipal.
Grows to a large size: the green branches are used to adorn houses during certain festivals; timber strong and good.—Sp. 6·5 inch. diam. Axis very eccentric, 5 | 1·5; all the layers cannot be counted. On the widest side of the axis are 27 layers in 0·85 inch. beginning from the axis; near the outside are 18 layers in 0·9 inch.; wood softer, of paler colour, and less lustre than English yew.

Teak. See Tectona.

406 Tectona grandis. Teak, fr. Martaban.
Several specimens of various qualities.

Teetakuth. See Rottlera.

Tendoo. See Diospyros.

Tengaun. See Hopea.

Teotosa. See Rhododendron.

407 Terminalia. Thuphanga, B. fr. Tavoy.

408 Terminalia bialata, fr. Martaban.

409 Terminalia Bellerica. Bauri, fr. Gualpara.
6 feet in girth; used for canoes: the fruit and bark used by tanners.—*Ham.*

410 Terminalia Catappa, fr. Bot. G.
A noble and most ornamental tree: wood very good.

411 Terminalia moluccana. Joynal, fr. Gualpara.
3 cubits in girth; used in boat-building, as the timber is both light and durable.—*Ham.*

412 Terminalia Hilka. Hilkha, fr. Gualpara,
6 feet in girth; used for canoes and for furniture.—*Ham.*

413 Ternstroemia napalensis, *De Cand*, fr. Nipal.
Sp. 3 inch. diam. Outer layers with very distinct rays, of a reddish brown; wood soft and spongy.

414 Ternstroemia. Puzzeen-zwa, B. fr. Tavoy.
A rather large tree, used for posts and rafters.

415 Tetradium ? cymosum, *Wall.* fr. Nipal.

416 Tetradium ? fr. Nipal.
A very large tree.

417 Tetranthera caduca. Pangch-Petiya, fr. Gualpara.
6 feet in girth; used for chests and common carpentry.—*Ham.*

418 Tetranthera. Haola, fr. Gualpara.
3 feet in girth; wood close and soft; used for coarse furniture.—*Ham.*

419 Tetranthera Paromouja. Paromouja, fr. Gualpara.
6 feet in girth; wood close and soft; used for coarse furniture.—*Ham.*

420 Tetranthera Dorodmeda. Vagnal or Bagonal, fr. Gualpara.
3 cubits in girth; used for coarse furniture.—*Ham.*

421 Teutha, B. fr. Tavoy.

Thathee. See Bignonia.

422 Thauga-et-thittoo, fr. Tavoy.
3 to 5 fathoms long, 8 to 12 inches diam. An inferior wood, used in small buildings.

423 Thau-baun-po, fr. Tavoy.
5 to 8 fathoms long, 12 to 18 inches diam. An inferior light wood, used for small canoes.

424 Thau-baun-thau-lay, fr. Tavoy.
6 to 12 fathoms long, 13 to 20 inches diam. Wood very pliant; little inferior to Hopea, but does not saw so kindly.

Thaumma See Sonneratia.

Thaun. See Eurya.

425 Theyah, fr. Tavoy.
4 to 6 fathoms long, 10 to 15 inches diam. An inferior wood, used in small buildings.

Thikadoo. See Sterculia.

Thittoo. See Sandoricum.

Thitya. See Laurus.

Thoun-ben. }
Thoun-pine. } See Artocarpus.

Thounkheea. See Pterocarpus.

426 Thounmynga, B. fr. Tavoy.
A middle-sized tree, used in house-building.

Thounsanga. See Myristica.

Thubbae. See Mimusops, Uvaria, Ficus.

Thubboobamboo. See Anacardium.

Thuggainee. See Bignonia.

Thuggoo. See Rhododendron.

427 Thunbergia coccinea, fr. Nipal.

Thaumagee. See Elæocarpus.

Thuphanga. See Terminalia.

Thuppan. See Ficus.

Thurape. See Callophyllum.

Thurratha. See Excœcaria.

428 Thymboo, B. Thau-baun-po, fr. Tavoy
5 to 10 fath. long. 15 to 20 inches diam. Good strong durable light wood; used in boat-building; does not saw kindly.

Tima. See Quercus.
Timbhus. See Xanthoxylon.
Tirbbue. See Quercus.
Tissee. See Salix.

429 Tomex, or Litsæa Japonica. Uluyaohama, fr. Gualpara.
6 feet in girth ; used for small canoes.—*Ham.*

Toomulsee. See Premna.
Toon. See Cedrela.

430 Town-pine, fr. Tavoy.
7 to 8 fathoms long, 18 to 30 inches thick ; used in boat-building; reckoned little inferior to Hopæa.

431 Trophis? aspera. Saora, fr. Gualpara.
3 cubits in girth ; used for joiner's work.—*Ham.*

Tuknee. See Polygonum.
Tukra. See Bauhinia.
Tunabeng. See Artocarpus.
Tungnusi. See Cinchona.

432 Turpinia pomifera. (Dalrymplea), Phurasee and Signa, N. fr. Nipal.
A large tree; wood of a dull grey colour, light, soft, compact, free-working, splits easily; not applied to any particular use.—Sp. 3·2 inch. diam. ; rays indistinct; tubes very small; bark thin, and the inner layer almost black.

433 Ulderoo, fr. Bombay.
Very little liable to split, and therefore used for fuses for bomb-shells.

Uluyaohama. See Tomex.

434 Uncaria pilosa, fr. Nipal.
A small and imperfect specimen.

Uriam. See Andrachne.

435 Urtica. Jeonagkun, N.; Latasishnoo, P.; fr. Nipal.

436 Urtica salicifolia, fr. Nipal.

437 Urtica pulcherrima, fr. Bot. G.

438 Uvaria. Thubboo, B. fr. Tavoy.
A large tree, used in boat-building.

439 Uvaria suberosa. Bandorkola, fr. Gualpara.
3 cubits in girth; a close-grained, soft, brittle wood; used for posts, beams, and planks.—*Ham.*

Vagnal. See Tetranthera.

440 Vangueria edulis. Moyen, fr. Gualpara.
A small timber tree, 4 feet in girth ; used for coarse furniture.—*Ham.*

441 Vernonia. Magor, fr. Gualpara.
3 cubits in girth ; used for coarse furniture. The only one of the numerous tribe of corymbiferous plants that grows to be a timber tree.

442 Vibernum? Loshima, N. fr. Nipal.

443 Vibernum erubescens, fr. Nipal.
A small-sized tree.

444 Vibernum cordifolium, fr. the Himalaya.

445 Vitex acuminata. Angchhui, fr. Gualpara.
3 cubits in girth. A very close, hard, brittle wood ; used for mortars of oil-mills, feet of bedsteads, &c.—*Ham.*

446 Vitex Babula. Babla, fr. Gualpara.
3 cubits in girth; wood close, soft, tough ; used for coarse furniture, but in little estimation.—*Ham.*

447 Vitex Leucoxylon. Bhodiya, fr. Gualpara.
3 cubits in girth; used in making ploughs; will grow on land that is inundated for weeks together.—*Ham.*

448 Vitis or Cissus, fr. Nipal.
Sp. 4·5 inch. diam.; wood spongy and very coarse-grained; fibre very small in proportion to the tubes, which are many and large; rays very distinct, of a reddish brown colour, forming a handsome waved figure; bark stringy.

449 Wrightia gigantea, *Wall.* fr. Nipal.
A large climber.—Sp. 2·5 inch. diam.; 10 layers; wood whitish, with considerable lustre; rather soft.

450 Wrightia antidysenterica. Lathon, B. fr. Tavoy.
A small tree; not used.

451 Wrightia tinctoria. (Indigo tree.)
The leaves yield indigo. The wood is "beautifully white, close-grained, coming nearer to ivory than any other known to me."—*Roxb.*

452 Xanthophyllum. Saphew, B.; Choo-muna, T.; fr. Martaban.
Very large; wood used for posts and rafters.

453 Xanthoxylon alatum. Timbhus, P. and N. fr. Nipal.
Wood soft and open-grained, like aspen; bark very tubercular.

454 Xylocarpus. Keannan, B. fr. Tavoy.
Timber from 10 to 20 feet long; very durable; used for furniture and in house-building.

Zeethee. See Ziziphus.

Zimboon. See Dillenia.

Zitha. See Castanea.

455 Ziziphus incurva. Harobaer, P.; Kadabusi, N.; fr. Nipal.
Wood in considerable estimation.—Sp. 3·5 inch. diam.; fibre brownish white, with little lustre; rays in the outer layers distinct, but of the same colour as the fibre; bark coarsely fibrous.

456 Ziziphus. Zeethee, B. fr. Tavoy.
Wood hard and durable.

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## III.—*Table for ascertaining the Heights of Mountains from the Boiling Point of water.* *By* James Prinsep, *Sec., &c.*

A correspondent has suggested to me that many readers of the JOURNAL are anxious to possess a ready means of measuring heights by the temperature of boiling water, as it frequently happens that they find themselves in situations where this simple method may be applicable when it is out of their power to resort to the more generally practised operation with a barometer.

I have accordingly drawn out a table founded on the best procurable data of the present time: but it must not be concealed that sufficient accuracy has not been attained in experimental researches on steam of low temperatures to warrant implicit reliance upon the results; for although, since the important application of steam as a motive power, numerous experiments have been made to ascertain the *elastic tension* which it exerts at different temperatures both below and above the ordinary boiling point; still, *below* 212°, the points fixed by experiment are at intervals of several degrees asunder, and there is no thorough accordance between those of different experimenters.

Perhaps it is necessary to explain, that the boiling point is that degree of heat at which the elastic force of aqueous vapour is just capable of counterpoising the pressure of the atmosphere, or the weight of the column of mercury in a barometer. The method then of discovering the law of progression of the tensions has generally had for its basis the exposure to heat of a portion of water in a closed vessel, such as a glass tube or a small boiler, under the pressure of a column of mercury, measuring the height to which the latter is raised at different temperatures.

Betancourt, Schmidt, Dalton, Watt, Creighton, Southern, Taylor, and more recently Ure, Arsberger, Perkins, and Dulong (assisted by a commission of the French Academie), are some of the illustrious names which are connected with these researches experimentally; while Robison, Young, Ivory, Laplace, Prony, Tredgold, Coriolis, Laroche and others have attempted to construct mathematical formulæ, capable of embracing the range of their experiments from the freezing point up to 500° Farh.* It is quite unnecessary for me to enter into any lengthened history of this branch of physics, which the reader will find ably discussed in *Robison's Mech. Phil., Biot, Tredgold on the Steam Engine, Daniell's Meteorology,* and in the report of Dulong to the Academie on *the experiments made by order of the French Government to determine the elastic force of aqueous vapour at high temperatures.* [*An. Chim.* xliii.]

All the experiments agree in proving the elastic force of steam to follow a geometrical ratio with arithmetical increments of heat. The index of the power representing the law of variation was assumed as 5.13 by Southern, 6 by Creighton, 7 by Young, by Coriolis 5,355, and by Dulong 5. But the formula of Tredgold is acknowledged to agree more closely with experiments below 300° than any other :—his exponent is also 6, with a different co-efficient; if $f$ = elastic force, and $t$ temperature, then by his formula

$$f = \left(\frac{t+100}{177}\right)^6 ; \text{ or } t = 177\, f^{\frac{1}{6}} - 100$$

in logarithms

$$\log. f = 6\,(\log.\,(t+100) - 2.247968)$$

* The experiments of the French Academicians Baron de Prony, Arago, Gerard and Dulong, in 1829, extend to the temperature of 435° Fahrenheit, or a pressure of 24 atmospheres, which they measured by absolute pressure of a column of mercury *sixty feet high* in a glass tube attached to the tower of the Old Church of Sainte Geneviéve:—they were afraid of passing this limit, as the least explosion would have brought down the tottering fabric. Their glass tube was jointed and ingeniously supported: Mr. Daniell has however since worked with *single* glass tubes of 40 feet long, in his water barometer experiments. We deal now-a-days boldly with feet, where inches were formerly thought sufficient!

With this formula I had constructed a table from 214° to 180°, when I perceived that the calculated pressures gradually gained upon the experimental ones within the same range, until at 180°, the difference was a full third of an inch. This will be seen in the diagram of Plate VIII, and in the following comparative table :

| Temperature | Calculated Tension by Tredgold's formula | Observed Tension | Differences | Observer |
|---|---|---|---|---|
| ° | in. | in. | | |
| 212 | 30.00 | 30.00 | 0 | assumed |
| 210 | 28.86 | 28.88 | +.02 | Ure |
| 210 | 28.86 | 28.82 | —.04 | Robison |
| 202 | 24.68 | 24.37 | —.31 | Wollaston |
| 200.75 | 24.07 | 24,00 | —.07 | Dalton |
| 200 | 23.71 | 23.60 | —.11 | Ure |
| 200 | 23.71 | 22.86 | —.85 | Robison |
| 190 | 19.35 | 19.00 | —.35 | Ure |
| 189.5 | 19.15 | 18.80 | —.35 | Dalton |
| 182 | 16.35 | 16.01 | —.34 | Southern |
| 180 | 15.67 | 15.16 | —.51 | Ure |
| 180 | 15.67 | 14.73 ? | —.94 | Watt |
| 178.25 | 15.10 | 14.60 | —.50 | Dalton |
| 173 | 13.46 | 13.18 | —.28 | Dalton |
| 172 | 13.17 | 12.72 | —.45 | Southern |

ROBISON's numbers are much too low : the others, DALTON's, SOUTHERN's, and URE's, agree pretty well together, gradually separating from the curve of TREDGOLD's formula. On the supposition that the experimental results, when they evince so much regularity, are more trustworthy than the calculus, (which is indeed empirically formed to suit them), I have made a deduction of [0.01 inch × number of degrees below 212], from the numbers in TREDGOLD's column, and then I find that the experimental and theoretical curves coincide very well throughout the range required for our purpose.

The extreme difference at 180° will thus amount to

| | inches. | | |
|---|---|---|---|
| log. of .................... | 15,67 | = | 1.19511 |
| log. of .................... | 15,31 | = | 1.18611 |
| | | | .00900 |

=90 fathoms or 540 feet, a quantity of too much magnitude to be passed over.

Having thus explained the construction of the following Table, I will proceed to make a few remarks on the mode of using the instrument to which it applies.

The Rev. F. J. H. Wollaston was the first to introduce the thermometer practically as a substitute for the barometer in measuring heights. His plan was merely to render the thermometer more delicate by increasing the bulb, and allowing the mercury to enter the capillary tube only when it approached the boiling point, so that a few degrees occupied the whole scale, and by a sliding nonius each degree could be divided into 200 parts or more. But it is evident that to compete with the barometer in *accuracy of indications,* the scale must have a range of the same length as that of the barometer,—say 15 inches, and the instrument would thus become fragile and unwieldy: to obviate this inconvenience, he formed a reservoir above the capillary tube, containing a small supply of mercury, so that when the boiling temperature should be so reduced as to bring the reading point to the foot of his 6-inch scale, a portion of mercury was to be added to bring it to the top of the scale, by an operation so delicate and difficult that I may safely say, and from experience too, that few travellers would resort to it in the field, and fewer still succeed if they attempted it. In 1817, he exhibited his thermometer to the Royal Society, and in 1820, he applied it to the measurement of Snowdon. On the latter occasion, he drew up a table of the value of the degrees between 214° and 202° in feet, founded on Doctor Ure's empirical formula of tensions; but, as this range only extends to an altitude of 5405 feet, it is evidently quite insufficient for the traveller in India, who may ascend to 18,000 feet and still see *Snowdons* towering above his head.

The error into which Wollaston fell was an attempt at too great sensibility. His instrument is beautiful in a laboratory, where it will serve to shew minute variations in the index error, as it may be called, of a barometer in the course of years, as I have frequently proved. But for rough work out of doors, accuracy must in some measure be sacrificed to strength and portability, the points in which alone the thermometer can boast superiority over the barometer. Captain Herbert was so well aware of this, that he had provided himself from England with ordinary thermometers divided, from 180° upwards, to the tenths of degrees: half a division thus represented about 25 feet, which in most cases was ample, especially when the zero of elevation, or level of the sea, was 1000 miles distant.

All who possess thermometers, therefore, divided to tenths of inches, may convert them into measurers of height, by attending only to a few trifling precautions in their use.

1. The *prime* boiling point 212° should be accurately verified by comparison with a good barometer, for the divisions of the instrument-makers are by no means to be trusted within the requisite limits. Thus,

on some standard thermometers in the Surveyor General's office, in our experiments on the standard bar, we found the boiling point erroneous *two degrees*: and Lieut. BURNES found his thermometer boil on the Caspian Sea at 213°⅓ which would make its surface 700 feet below the level of the Mediterranean, whereas it is only suspected of half that depression.

2. The metal or wooden scale should be cut off at some height above the bulb, as otherwise it is very difficult to obtain the temperature correctly, or even to attain full ebullition, on account of the rapid abstraction of heat by the scale, particularly if it be of metal.

3. The vessel in which the water is boiled should be of metal, closed loosely with a cover or cork through which the thermometer may pass, so that the bulb may remain a trifle above the surface of the water. To those who cannot provide themselves with a boiler similar to that of WOLLASTON, a shaving pot will be found to answer sufficiently well. The steam should issue freely through the vent for some time before the reading is taken.

A word or two, now, on the mode of applying the following table to the calculation of the height required.

1. When the thermometer has been boiled at the foot and at the summit of a mountain, nothing more is necessary than to deduct the number in the column of feet opposite the boiling point below, from the same of the boiling point above:—this gives an approximate height, to be multiplied by the number opposite the mean temperature of the air in Table II. for the correct altitude.

| | | | feet. |
|---|---|---|---|
| *Example.* | Boiling point at upper station ........ | 201.5 = | 5600 |
| | Ditto ——— at lower station ........ | 211.3 = | 350 |
| | | Approximate height, | 5250 |

Temperature of air, above, 35°
below, 50

Mean 42,5 = multiplier,............... 1.022

Correct altitude, ........ft. 5365.5

2. When the boiling point at the upper station alone is observed, and for the lower the level of the sea or the register of a distant barometer is taken, then the barometrical reading had better be converted into feet by the usual method of substracting its logarithm from 1,47712 (log. of 30 inches) and multiplying by .0006, as the differences in the column of "barometer" vary more rapidly than those in the "feet" column.

feet.

*Example.* Boiling point at upper station .. ...... 185° = 14548

Barom. at Calcutta (at 32°) 29.75

Logar. diff. = 1.47712— 1.47349 = ,00363 ×.0006 = 218

Approximate height 14330

Temperature, upper station, 76° } 80 = multiplier ........ 1.100
Calcutta, .. 84 }

Correct altitude, ft. 15763

3. Assuming 30.00 inches as the average height of the barometer at the level of the sea (which is however too much), the altitude of the upper station is at once obtained by inspection of table I, correcting for temperature of the stratum of air traversed, by table II.

TABLE I.—*To find the Barometrical Pressure and Elevation corresponding to any observed temperature of boiling water between* 214° *and* 180°.

| Boiling point of water. | Barometer (modified from Tredgold's formula.) | Logarithmic differences (or fathoms). | Total Altitude from 30.00 in. or the level of the Sea. | Value of each degree in feet of Altitude. | Proportional part for one-tenth of a degree. |
|---|---|---|---|---|---|
| ° | inches. | | feet. | feet. | feet. |
| 214 | 31.19 | | —1013 | | |
| 213 | 30.59 | .00 84,3 | — 507 | —505 | |
| 212 | 30.00 | 84,5 | 0 | —507 | |
| 211 | 29.42 | 84,9 | + 509 | +509 | |
| 210 | 28.85 | 85,2 | 1021 | 511 | 51 |
| 209 | 28.29 | 85,5 | 1534 | 513 | |
| 208 | 27.73 | 85,8 | 2049 | 515 | |
| 207 | 27.18 | 86,2 | 2566 | 517 | |
| 206 | 26.64 | 86,6 | 3085 | 519 | 52 |
| 205 | 26.11 | 87,1 | 3607 | 522 | |
| 204 | 25.59 | 87,5 | 4131 | 524 | |
| 203 | 25.08 | 87,8 | 4657 | 526 | |
| 202 | 24.58 | 88,1 | 5185 | 528 | |
| 201 | 24.08 | 88,5 | 5716 | 531 | 53 |
| 200 | 23.59 | 88,9 | 6250 | 533 | |
| 199 | 23.11 | 89,3 | 6786 | 536 | |
| 198 | 22.64 | 89,7 | 7324 | 538 | |
| 197 | 22.17 | 90,1 | 7864 | 541 | 54 |
| 196 | 21.71 | 90,5 | 8407 | 543 | |
| 195 | 21.26 | 91,0 | 8953 | 546 | |
| 194 | 20.82 | 91,4 | 9502 | 548 | |
| 193 | 20.39 | 91,8 | 10053 | 551 | 55 |
| 192 | 19.96 | 92,2 | 10606 | 553 | |
| 191 | 19.54 | 92,6 | 11161 | 556 | |
| 190 | 19.13 | 93,0 | 11719 | 558 | |
| 189 | 18.72 | 93,4 | 12280 | 560 | 56 |
| 188 | 18.32 | 93,8 | 12843 | 563 | |
| 187 | 17.93 | 94,2 | 13408 | 565 | |
| 186 | 17.54 | 94,8 | 13977 | 569 | 57 |
| 185 | 17.16 | 95,3 | 14548 | 572 | |
| 184 | 16.79 | 95,9 | 15124 | 575 | |
| 183 | 16.42 | 96,4 | 15702 | 578 | 58 |
| 182 | 16.06 | 96,9 | 16284 | 581 | |
| 181 | 15.70 | 97,4 | 16868 | 584 | |
| 180 | 15.35 | 97,9 | 17455 | 587 | 59 |

The fourth column gives the heights in feet.

TABLE II, *of Multipliers to correct the approximated Height for the Temperature of the Air.*

| Temp. of Air. | Multiplier. | Temp. of Air. | Multiplier. | Temp. of Air. | Multiplier. |
|---|---|---|---|---|---|
| ° | | ° | | ° | |
| 32 | 1,000 | 52 | 1,042 | 72 | 1,083 |
| 33 | 1,002 | 53 | 1,044 | 73 | 1,085 |
| 34 | 1,004 | 54 | 1,046 | 74 | 1,087 |
| 35 | 1,006 | 55 | 1,048 | 75 | 1,089 |
| 36 | 1,008 | 56 | 1,050 | 76 | 1,091 |
| 37 | 1,010 | 57 | 1,052 | 77 | 1,094 |
| 38 | 1,012 | 58 | 1,054 | 78 | 1,096 |
| 39 | 1,015 | 59 | 1,056 | 79 | 1,098 |
| 40 | 1,017 | 60 | 1,058 | 80 | 1,100 |
| 41 | 1,019 | 61 | 1,060 | 81 | 1,102 |
| 42 | 1,021 | 62 | 1,062 | 82 | 1,104 |
| 43 | 1,023 | 63 | 1,064 | 83 | 1,106 |
| 44 | 1,025 | 64 | 1,066 | 84 | 1,108 |
| 45 | 1,027 | 65 | 1,069 | 85 | 1,110 |
| 46 | 1,029 | 66 | 1,071 | 86 | 1,112 |
| 47 | 1,031 | 67 | 1,073 | 87 | 1,114 |
| 48 | 1,033 | 68 | 1,075 | 88 | 1,116 |
| 49 | 1,035 | 69 | 1,077 | 99 | 1,118 |
| 50 | 1,037 | 70 | 1,079 | 90 | 1,121 |
| 51 | 1,039 | 71 | 1,081 | 91 | 1,123 |

Enter with the mean temperature of the stratum of air traversed; and multiply the approximate height by the number opposite, for the true altitude.

The table of Tensions (tab. I.) is still avowedly imperfect. We see that the force of vapour for 210°, as found by observation, differs several hundredths of an inch from the formula of either DALTON, URE, or TREDGOLD, although only two degrees distant from the fixed point 212°. Nor can it surprise us to find it so, because its experimental determination, by heating vapour inclosed within the thick glass of a barometer tube, is necessarily subject to much more uncertainty than the obvious measurement of the boiling point, under a given pressure of the air. On the mountains of India, at Simla, Súbathú, Chirra Púnjí, and even *Spití*, wherever in short there may be observers in possession of good barometers, the power exists of rendering an essential service to physics by fixing so many points on the scale of tensions, in the latter more unexceptionable manner. For instance, an observer at Chirra, by carefully noting the heat of his boiling tea-kettle every morning, and inserting it in his register, together with the accurate height of the barometer, would determine that part of the thermometric scale corresponding to 25 and 26 inches of pressure. So with observations at Ságur, for 28 inches; at the Nilgherries for 21 inches; and in the Himálaya for even 15 inches: and I hope that this notice may have the effect of inducing this new and interesting species of *synthetical* research, as a check upon the scales framed on an opposite system in the laboratory.

## IV.—*Translation of a Tibetan Passport, dated A. D.* 1688. *By* M. Alex. Csoma de Körös.

[Read 24th April, 1833.]

In Hyde's *Historia Religionis Veterum Persarum* (2nd edition, page 552-3), there is an engraving of a passport granted by the governor (or grand Lama) of *Lassa,* to an Armenian, of which, at the time of its publication, no European was able to decypher the characters. The learned author's account of it is in the following words:

" Secundò damus *Scripturam Tatarorum de Boutan** (al. *Boutunt)* citra *Imaum* supra *Indiam.* Hujus lectio est á dextrâ†: et hocce ejusdem elegantissimum specimen est, id quod vulgò sonat, *un passport,* seu *salviconductùs* literæ, â principe urbis et provinciæ de *Boutan* datæ, nuperis annis, *Chogja Ouanni* (i. e. Domino Joanni) mercatori *Armeno* ibidem negotianti: et dictus princeps nomen suum (ut vides) *sigilli* loco et forma majusculis et implicatis characteribus infra apposuit. Talis sigilli impressio *arabibus* dicitur توقيع *taukía; Persis et Turcis* طغرا *togrâ,* unde, apud eos, talis majusculorum characterum scriptor, aut talis sigilli factor, vel appositor seu principis subsignator, vocatur *Tográí.* Hanc chartam nobiscum communicavit singularis amicus D. Joh. Evans S. T. D. nuperis annis ex India redux."

The character of this curious manuscript proves to be the small running-hand of the Tibetans, written and engraved with hardly a single error. The following is a version of it in Roman characters, which may be interesting to those who possess Hyde's very learned volume.

Chhos-*h*khor *d*Pal-gyi Lha-sa nas.—*r*Gya-gar *h*phags-yul bar-gyi Sa-lam-du *h*khod-pahi Ser, *s*kya, drag, zhan, Lhahi mi-*r*je *r*dsong *bs*dod *g*nyer las-*h*dsin, Sog, Bod, Hor, *h*Brog, ir-*h*chhihi *h*grul *h*grims, lam *h*phrangs *b*srung *b*kag, *r*gan mi *d*mangs bya-va zhi drag-gis sné slébs *b*chas *m*thah-dag-la springs-pa.—Lha-sa p'hun-ts'hogs *l*chang-lo-chan-gyi *h*gron-po *m*Go-*d*kar‡ It'hang-na-chan mi *b*zhi zhon khal *b*chu-drug *b*chas nyé-khohi ts'hong gyur grubs-nas rang yul-du log *h*gro-var *s*tahur-gyi (? Lhahur-gyi) *m*ts'hon gang spyihi par rog nyan-du gang *h*gro-las sné gor *h*p'hrog *b*chom sogs *g*nod *h*gol-du log-par *h*gro-va nyan ma byed-par phar phyir-du *b*de-var *h*grims-chhug.—Zhes sa-*h*brug zla ts'hes-la lugs *g*nyis kyi *m*dun-sa Chhos-*h*khor chhen-po *d*Pal-gyi Lha-sa nas bris.

* *Boutan,* though applied by Europeans and Mohammudans to Tibet generally, is properly the name of one of the southern provinces, called in Tibetan *Llopato*: *Lhassa* is the capital of Tibet Proper or *U-tsang.* [See Journ. As. Soc. i. 123.]

† This is of course a mistake: the Tibetan reads like the Sanskrit from the left hand.

‡ The name *m*Go-*d*kar (properly white-headed, but rendered by me, above, by Mohammedans) formerly was applied in Tibet both to the Muhammedans of India and to the Europeans. But of late the Tibetans have commenced calling the Europeans by the name of Philing-pa, and an European of British India by that of *r*Gye-Philing (-pa) or Indo-European.

Bod-pahi zla *h*dres med-ching lo-thog mi-khal-gyi *h*khri *s*grub dés *h*gré byung phyin *b*dé-var *h*grims chhug.

A square seal.

*Translation.*

"From the noble (city) Lhassa, the circumambulating race of religion.—To those that are on the road as far as *Arya Dèsa* or India, to clerical, laical, noble, ignoble lords (or masters) of men; to residents in forts, stewards, managers of affairs, to Mongols, Tibetans, Turks, and to dwellers in tents in the desert; to ex-chis (or el-chis, envoys, or public messengers, vakíls or ambassadors, &c.) going to and fro; to keepers and precluders of bye-ways (or short-cuts); to the old (or head) men, collectively, charged to perform some business of small or great importance; to all these is ordered (or is made known). These four foreign (or travelling) persons residing at Lhassa, *l*chang-lo-chan, Mohammedans of It'hang-na, after having exchanged their merchandize, going back to their own country, having with them sixteen loads on beasts; having nothing for their defence except some Lahorí-weapons,—do not hinder, rob, plunder, et cetera, them; but let them go to and fro in peace.

Thus has been written from the noble Lhassa, the great religious race, from the senate-house of both ecclesiastical and civil affairs, in Sa-*h*brug* (in the year of T. ch. 1688). On the day of the month. (These dates are wanting).

*Note.*—There is no Tibetan joined with them. They have about a man's load of victuals wrapped up in a bundle; with that there has been made an increase (of packages), but let them go in peace."

A square seal.
in Horr character

* Sa-*h*brug *(earth's dragon)* is the title of the second year of the Tibetan cycle of sixty years: it corresponds with *Vibhava* of the Indian and *Vú Dhín* of the Chinese cycle. The Tibetan reckoning commences from February, 1026: as therefore Hyde's first edition was printed in 1701, and he uses the expression "*nuperis annis ex India redux*," the MSS. has been referred to the twelfth cycle, then current, which fixes its date to the year 1688.

Colonel Warren in the *Kala Sankalita* (Chron. tab. xxi.) has given a full description of the Indian system;—a catalogue of the Tibetan cycle, which is two-fold, one following the Sanskrit, the other following the Chinese system, will be published in the Tibetan Dictionary now preparing for the press.

## V.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 24th April*, 1833.

The Honorable Sir Edward Ryan, President, in the Chair.

The minutes of the last meeting were read.

Mr. B. H. Hodgson, Resident at the Nipalese Court, the Rev. Josiah Bateman, and Mr. D. Macfarlan, were elected Members.

Read a letter from the Secretary to the Right Hon'ble Sir R.W. Horton, Governor of Ceylon, expressing acknowledgments for his Excellency's election as an Honorary Member, and presenting a copy of the Ceylon Almanac for 1833, containing much unpublished information on the history of Ceylon.

Read a letter from the President of the Central Committee of the Geographical Society of Paris, acknowledging receipt of the 6, 7, 8, 12, 13, 14, 15, and 16 volumes of the Researches.

Read a letter from J. Forshall, Esq. Secretary to the British Museum, acknowledging the receipt of the Journal As. Soc. 1832.

Read a letter from Col. Wm. Casement, Secretary to Government, Military Department, forwarding on the part of the Madras Government:

" Results of the Astronomical Observations made at the Madras Observatory, vol. 1st, 1831, by T. G. Taylor, Esq. H. C. Astronomer."

The following books were presented by the Venerable Archdeacon Corrie, on the part of the Rev. Joseph Wolff.

1. Armenian Calendar, printed at Constantinople in the Armenian Era 1151 or A. D. 1702.

Mr. J. Avdall pointed out the following historical memorandum written on the cover of this work in Armenian, probably at Cabul.

" In the year 1824, on the 23rd July, Habib Ullah Khan was conquered by Dost Mohammed Khan."

2. Devotional Meditations, written by St. Gregory Narekenses, in the beginning of the 11th century, and published at Constantinople in 1185, Armenian Era, or A. D. 1736.
3. Tawáríkh Khán Jahání o Makhzaní Afgháné, 1st vol.
4. Táríkh Akberí.
5. Shojráwalosat Afghání o Faris.
6. Qorán Sheríf.

The following books were presented by Monsieur Murelatour, their author.

1. Premier fruit des trois jours de Gloire, Paris 1831.
2. Le Siege D'Eden Allegorie Orientale, Paris 1827.
3. Triomphe de L'Amour sur le Fanatisme et le Materialisme, Paris 1828.

The following book was presented by the author.

Rasselas, translated into Bengalee, by Maha Raja Kalikishen Bahadur.

Mr. Csoma de Körös presented a Catalogue of the Tibetan Books in the Society's Library, with a recommendation that the numerous duplicates and extra copies of several of them should be presented to learned Societies in Europe*.

* As soon as we are in possession of Tibetan type, we shall give insertion to this valuable catalogue. —Ed.

*Antiquities.*

Read a letter from W. Storm, Esq. presenting for deposit in the cabinet, the three coins exhibited to the Society on the 5th September, 1832.

These coins were found in estate No. 100 (No. 74 of Captain Prinsep's Soondurbun Map), west of the ruins of Bishenpúr, on the Ishamatí or Jabuna river, near an old temple called *Mót Búré.*

The Secretary noticed a simple method employed by the natives in taking off facsimiles of coins on paper : they daub a little printer's or *pakka* ink on the projecting parts of the coin, and then transfer it by pressure on to the fleshy part of the thumb —thence a faithful representation is impressed upon the paper, previously wetted, which has the advantage of not being reversed.

Four silver coins found at Agra, 1 of Akber, 2 of Jehangír, and 1 of Alamgír II—*presented by Capt. J. T. Boileau, Engineers.*

*Literary.*

Translation of a Tibetan Passport, engraved in Hyde's *Religio Persarum.* By M. A. Csoma de Körös.

[This will be found in the present number, p. 201.]

Selections from Mr. Csoma's translations from the *b*Stan-*h*gyur were also read—among them, the letter of RATNAVALI, a young Princess of Ceylon, to SHAKYA, and the reply of the sage. This letter is generally known in Tibet, and is introduced in every collection of epistolary forms.

[The want of Tibetan type obliges us to defer the insertion of this curious morçeau, which however is but a literal translation from the Sanskrit.]

*Physical.*

A gigantic specimen of Fossil Ammonite, from the Carboniferous Limestone of Swansea, was presented by Lieut. J. A. Crommelin, Engineers.

Read a letter from Lieut. J. T. Smith, Masulipatam, forwarding the Geological specimens of the late Dr. Voysey, alluded to at the last meeting; also the following mentioned in Dr. Malcolmson's letter.

1. Fragment of the Meteorolite, which fell in the Cadapah district 2nd January, 1831*.

2. Fossil Shell and Bone, noticed at the meeting of the 20th February.

3. Limestone from Warapilly, which seems well adapted for Lithographic purposes.

4. Fragment of Bone, from a Cave in the neighbourhood of Hyderabad, explored by Dr. Malcolmson, who gives the following description of it.

"Some interesting facts occurred to me the other morning in a ride to a large mass of granite rock near this, which is rent into fissures of great depth, forming dens inhabited by hyænas and *chitas*, extending through the bottom of the little hill to unknown depths. Having entered one of the rents, I was struck with the masses of fallen rock on each side being covered with stalagmite formed from the water running down from the sides of the rent 40 feet above, and still more by observing that the sides of the narrow passage bore a fine polish, which my companion immediately exclaimed, must be caused by the animals passing out of a cave at the end of the fissure he had been examining. I had the same thing in view, and was at the time observing how far it could be caused by the water. In tracing the same appearance in other places, it was only observed where the animals would necessa-

* Vide GLEANINGS, iii. 389.

rily pass, and, when the stones projected by a sharp point into the path, the angles only were polished. The den was low, and numerous bones lay scattered in the outer parts into which I crawled: the foot marks of the animals were distinct and fresh. Most of the bones were much broken, and the dung of the hyænas near the place were full of large pieces of ribs, unbroken tarsal bones, &c. During the search, I was astonished at the vast numbers of rats' heads and bones found in the place in little heaps, evidently out of reach of the hyænas, and often on the top of insulated blocks; these were below the fissures open at the top, and the dung of hawks readily suggested that they were dropped by these birds, which was confirmed by a large feather of one found with the bones. Some of the bones were surrounded with the fur of the animal, and had been only recently voided; and what was remarkable, the upper and lower jaw were not separated, but the flesh beautifully cleaned away by the digestive process; the other bones were entire, although disunited. In the larger skulls, the back part had been broken, and in one only, crushed. In a few minutes, I removed a plate full of skulls and other bones, amongst which are three species of mus, squirrel, sorex, bats, and birds. Had the rock been of lime ~~and~~ stone, fossil animal remains would have been found. The curious confirmation of Buckland's supposition regarding the polished blocks in the caves appears to me very interesting, as his views stood much in need of illustration from the habits of living species."

Specimens of Fossil Shells from Jabulpúr—*presented by Dr. Spilsbury.*

" The locality of the fossil shells, which I have at length the pleasure to send to the Society, lies about 18 or 20 miles east of Jabalpúr. The first three miles cross a sandy plain, which abruptly terminates at a small rivulet; when the soil changes to the black alluvial one of the valley. At six miles cross the Gour river, a rough ghát of *trap*: the road winds on between trap hills varying from 50 to 300 feet high. I encamped at *Suleya* on the same river (here 200 feet broad): the bed intersected with veins of heliotrope, quartz, massive and crystallized. The road then led through an undulating country, with irregular masses of trap, and for less than a mile beyond, masses of the accompanying shell breecia, from a single shell to large blocks of two feet, extend, mixed with the trap, over a space about 300 feet square. The spot had been under *tillee* cultivation. There was no *nálá* or ravine near, whence I could judge of the nature of the substrata, but at no great distance I could see the trap appearing precisely as in the bed of the river. I asked the lime-burner how he came to discover them? His account was, that he is in the habit of taking small quantities of lime to the neighbouring villages for sale, and in his travels has an eye to the *geological features* of the country as far as limestone is concerned:—passing this field some nine or ten months ago he was struck with the very different appearance and color of the stones,—and hence the discovery of these fossil shells."

The matrix of these shells appears to be indurated clay, and the forms of the shells are in most cases replaced with silicious matter; they resemble, as Dr. Spilsbury suggests, the buccinum and other shells in the Gawelgir range of hills described by Voysey, (Gleanings, vol. i. p. 356*.)

Some specimens of Minerals from Manipur, Kachár, Kabú, and Assam, including fossil wood from the Níngti river—*presented by Captain R. B. Pemberton.*

* We hope ere long to present our readers with drawings of these shells.—Ed.

## VI.—*Miscellaneous.*

### 1.—Indian Meteorology.

1.—*Meteorological Register kept at Bijnore, (Northern Moradabad,) by E. J. Ravenshaw, Esq,*

| | At 10 A. M. | | At 4 P. M. | | Remarks. |
|---|---|---|---|---|---|
| | Bar. | Ther. | Bar. | Ther. | |
| July 21 | 28,86 | 86 | 28,77 | 87 | Rain in the morning. |
| 22 | .. | .. | 28,75 | 87 | Fair all day. |
| 23 | 28,85 | 88 | 28,75 | 90 | Ditto, very cloudy at sunset. |
| 24 | 28,83 | 82 | 28,75 | 83 | Rain in the morning and more or less all day. |
| 25 | 28,90 | 85 | 28,75 | 85 | Fair all day. |
| 26 | 28,83 | 83 | 28,75 | 86 | Rain in the morning; fair after 11 o'clock. |
| 27 | 28,78 | 85 | 28,74 | 84 | Wind and rain at noon. |
| 28 | 28,76 | 86 | 28,74 | 37 | High wind at 10; cloudy; all day rain. |
| 29 | 28,75 | 86 | 28,73 | 88 | Cloudy; all day rain. |
| 30 | 28,79 | 86 | 28,73 | 88 | Cloudy; all day rain. |
| 31 | 28,76 | 87 | 28,74 | 87 | Ditto. |
| Aug. 1 | 28,84 | 83 | 28,74 | 84 | Rain; in morning clear. |
| 2 | 28,79 | 85 | 28,74 | 87 | Fair all day. |
| 3 | 28,78 | 85 | 28,75 | 88 | Slight rain at 10; clear afterwards. |
| 4 | 28,86 | 84 | 28,80 | 85 | Clear at 10; rain morning. |
| 5 | 28,86 | 85 | 28,76 | 84 | Heavy rain at 1 P. M. |
| 6 | 28,83 | 85 | 28,76 | 85 | Clear all day till 4 P. M. slight rain. |
| 7 | 28,82 | 84 | 28,74 | 85 | Cloudy. |
| 8 | 28,90 | 82 | 28,83 | 84½ | Thunder storm and very heavy rain in the morning; clear after 10 A. M. |
| 9 | 28,95 | 82½ | 28,85 | 84½ | Fair all day, with clouds. |
| 10 | 28,96 | 83½ | 28,85 | 86½ | Fair all day, ditto. |
| 11 | 28,92 | 84½ | 28,83 | 86 | Ditto. |
| 12 | 28,85 | 83½ | 28,75 | 85 | Ditto. |
| 13 | 28,80 | 82½ | 28,80 | 84½ | Light rain in the morning; fair all day. |
| 14 | 28,86 | 81½ | 28,80 | 84 | Fair all day, with clouds. |
| 15 | .. | .. | 28,80 | 83 | Ditto. |
| 16 | 28,90 | 82½ | 28,80 | 84½ | Ditto. |
| 17 | 28,86 | 84½ | 28,80 | 87 | Ditto. |
| 18 | 28,88 | 85½ | .. | .. | Very cloudy in afternoon. |
| 19 | .. | .. | 28,76 | 86½ | Fair, with clouds and distant clouds. |
| 20 | 28,85 | 82 | 28,76 | 84½ | Fair, with clouds. |
| 21 | 28,93 | 81 | 28,84 | 81 | Heavy rain at night, and in morning. |
| 22 | 28,90 | 81½ | 28,80 | 84 | Fair, with clouds. |
| 23 | 28,86 | 84 | 25,77 | 86 | Ditto. |
| 24 | 28,90 | 82 | 28,86 | 82 | Ditto; west wind. |
| 26 | 28,80 | 83 | 28,76 | 86 | Ditto. |
| 27 | 28,90 | 82 | 28,87 | 80 | Rain at night and afternoon. |
| 28 | 28,96 | 80½ | 28,88 | 83 | Rain in morning; fair afternoon. |
| 29 | 28,94 | 82 | 28,84 | 86 | Fair. |
| 30 | 28,89 | 82½ | 28,80 | 86 | Strong westerly wind; fair. |
| 31 | 28,86 | 82 | .. | .. | Ditto. |
| Sept. 1 | 28,92 | 83 | 28,84 | 86 | Ditto. |
| 2 | 28,97 | 85 | 28,87 | 87 | Ditto. |
| 3 | 28,95 | 86 | 28,92 | 87 | Wind and rain in the afternoon. |
| 4 | 28,99 | 85 | 28,89 | 87 | Fair. |
| 5 | 28,93 | 85 | 28,85 | 87 | Ditto. |
| 6 | 28,92 | 84 | 28,83 | 86 | Ditto. |
| 7 | .. | .. | 28,78 | 88 | Ditto. |
| 8 | 28,90 | 83 | 28,82 | 84 | Ditto. |
| 9 | 28,90 | 83 | 28,80 | 86 | Ditto. |
| 10 | 28,91 | 83 | 28,84 | 86 | Ditto. |
| 11 | .. | .. | 28,90 | 84½ | Ditto. |
| 12 | 28,99 | 83 | .. | .. | |
| 13 | 29,00 | 83½ | 28,93 | 86 | Ditto. |

*Meteorological Register kept at Bijnore, (Northern Moradabad,) by E. J. Ravenshaw, Esq. (continued.)*

| | At 10 A. M. | | At 4 P. M. | | Remarks. |
|---|---|---|---|---|---|
| | Bar. | Ther. | Bar. | Ther. | |
| Sept. 14 | 29,00 | 83 | 28,95 | 87 | Strong west wind in the morning. |
| 15 | 29,03 | 83 | 28,97 | 87 | Ditto west wind; fair. |
| 16 | 29,04 | 80 | 28,96 | 87 | Ditto; ditto; cloud of locusts. |
| 17 | 28,96 | 83½ | 28,88 | 87 | Ditto. |
| 18 | 28,96 | 84 | 28,90 | 86 | Fair. |
| 19 | 29,07 | 84 | 29,03 | 86 | Ditto. |
| 20 | 29,13 | 83 | 29,05 | 87 | Ditto. |
| 22 | 29,03 | 79 | .. | .. | Ditto. |
| 23 | 29,10 | 82 | 29,00 | 84 | |
| 24 | 29,10 | 79½ | 29,00 | 82 | |
| 25 | 29,10 | 80 | 29,00 | 82 | Rain about 1 P. M.; cloudy evening |
| 26 | 29,10 | 79 | 29,04 | 82 | Fair. |
| 27 | 29,12 | 79 | 29,06 | 82½ | Ditto. |
| 28 | 29,16 | 81 | 29,10 | 83 | Ditto. |
| 29 | 29,23 | 80½ | 29,15 | 83 | Ditto. |
| 30 | 29,18 | 81 | .. | .. | |
| Oct. 1 | 29,16 | 82 | 29,10 | 81½ | Cloudy with rain. |
| 2 | 29,15 | 79 | 29,9 | 82 | Clouds. |
| 3 | 29,16 | 81 | 29,9 | 84 | Fair. |
| 4 | 29,20 | 80 | 29,9 | 83 | Ditto. |
| 5 | 29,21 | 79 | 29,10 | 84 | Ditto. |
| 6 | 29,20 | 81 | 29,6 | 83 | Ditto. |
| 7 | 29,10 | 82 | 28,98 | 84 | Ditto. |
| 8 | 29,00 | 79 | 28,97 | 85 | Ditto; high wind, w. |
| 9 | 29,05 | 80 | 28,99 | 85 | Ditto; ditto. |
| 10 | 29,10 | 78 | 29,03 | 84 | Ditto; ditto. |
| 11 | 29,10 | 76 | 29,03 | 82 | Ditto. |
| 12 | 29,15 | 77 | .. | .. | High easterly wind. |
| 13 | 29,23 | 77 | 29,17 | 81 | Fair; no wind. |
| 14 | 29,23 | 71 | 29,19 | 80 | Ditto. |
| 15 | 29,25 | 76 | 29,20 | 80½ | Ditto. |
| 16 | 29,30 | 75 | 29,20 | 80 | Ditto; W. breeze. |
| 17 | 29,34 | 73½ | 29,23 | 78 | |
| 18 | 29,30 | 74 | 29,20 | 78 | |
| 19 | 29,27 | 72 | .. | .. | |
| 20 | 29,25 | 72 | .. | .. | |
| 21 | 29,26 | 73 | 29,19 | 71 | |
| 22 | 29,24 | 71½ | 29,18 | 78 | |
| 23 | 29,19 | 73 | .. | .. | |
| 24 | 29,16 | 72 | .. | .. | |
| 25 | .. | .. | 29,12 | 76 | |
| 26 | 29,24 | 72 | 29,20 | 71½ | |
| 27 | .. | .. | 29,23 | 71½ | |
| 28 | 29,31 | 74½ | 29,24 | 75 | |
| 29 | 29,36 | 75 | .. | .. | |
| 30 | 29,35 | 74 | .. | .. | |
| 31 | 29,24 | 73 | .. | .. | Clouds in the evening. |
| Nov. 1 | 29,24 | 74 | .. | .. | High easterly wind; clouds. |
| 2 | 29,23 | 74 | 29,15 | 77 | Ditto. |
| 3 | 29,22 | 75 | 29,15 | 77½ | Ditto. |
| 4 | 29,24 | 73 | 29,16 | 75 | Ditto. |
| 5 | .. | .. | 29,22 | 75¾ | |
| 6 | 29,34 | 71 | 29,30 | 74 | |
| 10 | .. | .. | 29,20 | 75 | Rain in the evening. |
| 12 | 29,37 | 70 | .. | .. | |
| 26 | 29,33 | 68 | .. | .. | |
| 27 | 29,30 | 68 | .. | .. | |
| 29 | 29,32 | 69 | .. | .. | Cloudy; wind easterly; light rain. |
| 30 | 29,33 | 70 | . | .. | |

N. B. Fever and ague prevalent from the beginning of September to end of October.

2.—*Meteorological Register kept at Mozufferpúr, Tirhoot, by T. Dashwood, Esq.*

| Date. | Barometer. | | Ther. in doors. | | Ther. out of doors. | | Wind. | Weather. |
|---|---|---|---|---|---|---|---|---|
| | 9¾ A.M. | 4½ P.M. | 9¾ A.M | 4½ PM | Mx. | Min. | | |
| Dec. | | | | | | | | |
| 1 | 29,76 | | 69 | | 78,5 | 60 | E. | Clear, but foggy morning. |
| 2 | ,71 | 29,67 | 69 | 73 | 79 | 57 | W. | Clear, ditto. |
| 3 | ,74 | ,67 | 67 | 71 | 78 | 60 | E. | Clear; thick fogs. |
| 4 | ,80 | ,68 | 68 | 71 | 75 | 59 | W. | Clear, but drizzling rain in the morning. |
| 5 | ,78 | ,70 | 67 | 70 | 73,5 | 57 | W. | Clear all day. |
| 6 | | ,73 | | 68 | 73 | 57 | W. | Clear. |
| 7 | ,78 | ,69 | 66 | 68 | 74 | 58 | W. | Clear, with light clouds in the afternoon. |
| 8 | ,72 | ,67 | 66 | 68 | 74 | 59 | W. | Fair, with light floating clouds. |
| 9 | ,77 | ,70 | 66 | 69 | 75 | 61 | N. W. | Light floating clouds all day. |
| 10 | ,77 | ,69 | 66 | 67 | 71,5 | 61 | N. W. | Cloudy all day. |
| 11 | ,77 | ,70 | 66 | 66 | 67,5 | 56 | E. | Rainy morning, fog; but clear evening. |
| 12 | ,75 | ,66 | 64 | 65 | 67,5 | 53 | W. | Thick fog; clear evening, with high wind |
| 13 | ,72 | ,70 | 62 | 62 | 66 | 47 | W. | Clear, with morning fog. |
| 14 | ,75 | ,66 | 61 | 63 | 67 | 53 | E. | Fog, and clear day. |
| 15 | ,71 | ,65 | 61 | 64 | 70 | 53 | E. | Fog, but fine day. |
| 16 | ,76 | ,66 | 60 | 66 | 72,5 | 55 | E. | Clear. |
| 17 | ,80 | ,70 | 63 | 65 | 73,5 | 55 | E. | Clear. |
| 18 | ,78 | ,67 | 62 | 65 | 70 | 52 | W. | Clear. |
| 19 | ,68 | ,64 | 61 | 63 | 68 | 50 | W. | Clear. |
| 20 | ,76 | ,66 | 60 | 63 | 68 | 47 | W. | Clear. |
| 21 | ,73 | ,65 | 59 | 62 | 67 | 49 | W. | Clear. |
| 22 | ,70 | ,61 | 60 | 63 | 68 | 52 | W. | Clear, but morning fog. |
| 23 | ,61 | ,59 | 60 | 63 | 70 | 49 | W. | Clear. |
| 24 | ,66 | ,60 | 60 | 63 | 71 | 53 | E. | Clear. |
| 25 | ,67 | ,66 | 60 | 64 | 73 | 49 | W. | Clear. |
| 26 | ,70 | ,66 | 59 | 62 | 66 | 45 | W. | Clear. |
| 27 | ,76 | ,68 | 57 | 61 | 66 | 48 | W. | Clear. |
| 28 | ,79 | ,70 | 58 | 61 | 67 | 47 | W. | Clear. |
| 29 | ,77 | ,69 | 58 | 61 | 67,5 | 45,5 | W. | Clear. |
| 30 | ,79 | ,72 | 57 | 60 | 65 | 42 | W. | Clear. |
| 31 | ,87 | ,78 | 54 | 59 | 62 | 41 | W. | Clear. |
| Jan. | | | | | | | | |
| 1 | 29,96 | 29,86 | 55 | 57 | 62,5 | 43 | W. | Clear; fine frosty. |
| 2 | ,92 | ,80 | 55 | 58 | 64 | 45 | W. | Clear; frosty. |
| 3 | ,87 | ,74 | 55 | 58 | 66,5 | 50 | W. | Clear; light clouds. |
| 4 | ,86 | ,73 | 56 | 60 | 66,5 | 48 | E. | Rainy morning, and cloudy afternoon. |
| 5 | ,86 | ,80 | 56 | 60 | 71 | 49 | E. | Fine, with light clouds. |
| s | ,91 | ,83 | 57 | 62 | 72 | 53 | E. | Fog, and clear day. |
| 7 | ,90 | ,77 | 60 | 63 | 72 | 53 | E. | Fog, and clear day, and west wind. |
| 8 | ,79 | ,71 | 60 | 61 | 70 | 49 | W. | Clear. |
| 9 | ,81 | ,71 | 60 | 61,5 | 69 | 52 | W. | Clear. |
| 10 | ,85 | .. | 59,5 | .. | 70 | 54 | E. | Clear. |
| 11 | ,80 | ,69 | 61 | 65 | 71 | 54 | W. | Clear. |
| 12 | ,66 | ,60 | 61 | 65 | 73 | 53 | W. | Clear. |
| 13 | ,70 | ,60 | 61 | 65 | 73 | 55 | E. | Fine, with light clouds. |
| 14 | ,68 | ,60 | 62 | 65 | 73 | 51 | W. | Clear, and strong west wind. |
| 15 | ,79 | ,70 | 60 | 62 | 68 | 51 | W. | Rain, and cloudy. |
| 16 | ,66 | ,60 | 60 | 63 | 72 | 54 | W. | Clear, and strong wind. |
| 17 | ,72 | ,61 | 60 | 62 | 67 | 49 | E. | Light clouds all day. |
| 18 | ,73 | ,66 | 59 | 63 | 70 | 50 | W. | Clear. |
| 19 | ,78 | ,74 | 60 | 62 | 68 | 48 | W. | Clear. |
| 20 | ,83 | ,77 | 59 | 61 | 68 | 47 | W. | Clear. |
| 21 | ,88 | ,80 | 58 | 61 | 67 | 47 | W. | Clear. |
| 22 | ,87 | ,78 | 58 | 61 | 68 | 48 | W. | Clear. |
| 23 | ,86 | ,77 | 58 | 61 | 69 | 48 | W. | Clear. |
| 24 | ,90 | ,80 | 59 | 61 | 69,5 | 48 | W. | Clear, and east wind in afternoon. |
| 25 | ,90 | ,80 | 57 | 62 | 70 | 53 | E. | Slight fog, and light cloudy afternoon. |
| 26 | ,90 | ,80 | 60 | 63 | 71 | 53 | E. | Clear, with flying clouds. |
| 27 | ,89 | ,77 | 60 | 63 | 71 | 54 | W. | Clear. |
| 28 | ,90 | ,78 | 60 | 64 | 71,5 | 51,5 | E. | Clear, and N. wind in afternoon.. |
| 29 | ,90 | ,80 | 61 | 64 | 73 | 55 | E. | Foggy morning, and wind in afternoon. |
| 30 | ,94 | ,70 | 62 | 66 | 74,5 | 56 | E. | Fog and hazy all day, and wind afternoon. |
| 31 | ,77 | ,67 | 64 | 67,5 | 76 | 58 | S. E. | Clear. |

*Meteorological Register kept at Mozufferpúr, Tirhoot, by T. Dashwood, Esq.* 1833.

| Date. | Barometer. | | Ther. in doors. | | Ther. out of doors. | | Wind. | Weather. |
|---|---|---|---|---|---|---|---|---|
| | $9\frac{3}{4}$ A. M | $4\frac{1}{2}$ P. M. | $9\frac{3}{4}$ A. M. | $4\frac{1}{2}$ P. M. | Mx. | Min. | | |
| Feb. | | | | | | | | |
| 1 | 29,80 | 29,70 | 63 | 67 | 75 | 55 | E. | Rainy morning, but clear day. |
| 2 | ,79 | ,70 | 63 | 69 | 79 | 58 | E. | Clear. |
| 3 | ,80 | ,68 | 64 | 68 | 74 | 59 | E. | Cloudy all day and rain in the night. |
| 4 | ,88 | ,71 | 64 | 66 | 74 | 58 | S. W. | Cloudy, a rainy morning, fair afternoon. |
| 5 | ,67 | ,61 | 63 | 66 | 73 | 58 | E. | Thick fog, and clear and W. wind in |
| 6 | ,60 | ,60 | 64 | 66,5 | 71,5 | 51 | W. | Thick fog, and clear day. [afternoon |
| 7 | ,63 | ,59 | 62 | 68 | 70,5 | 53 | W. | Clear. |
| 8 | ,67 | ,59 | 62 | 67 | 74 | 53 | W. | Clear, and strong wind. |
| 9 | ,66 | ,59 | 63 | 66 | 74 | 53 | W. | Clear,and afternoon cloudy & one show- |
| 10 | ,60 | ,58 | 62,5 | 67 | 73 | 56 | W. | Clear. [er of rain. |
| 11 | ,60 | ,58 | 64 | 65 | 70 | 55 | W. | Hazy and cloudy all day. |
| 12 | ,69 | ,60 | 64 | 68 | 75,5 | 54 | W. | Clear with strong wind. |
| 13 | ,70 | ,60 | 63 | 69 | 77 | 52,5 | W. | Clear with violent W. wind. |
| 14 | ,70 | ,61 | 63 | 67 | 74,5 | 52 | W. | Clear with violent W. wind. |
| 15 | ,74 | ,61 | 63 | 66 | 72 | 51,5 | W. | Clear. |
| 16 | ,72 | ,63 | 62 | 66 | 72,5 | 50,5 | W. | Clear. [of rain at night. |
| 17 | | ,63 | | 67 | 76 | 52 | E. | Hazy morning and clear day,and shower |
| 18 | ,78 | ,66 | 65 | 70 | 73 | 53,5 | E. | Strong wind and clear day. |
| 19 | ,84 | ,73 | 62 | 68 | 76 | 55 | W. | Fair. |
| 20 | ,82 | ,75 | 65 | 68 | 77 | 53 | E. | Clear morning and cloudy day. |
| 21 | ,76 | ,66 | 64 | 68 | 77,5 | 55 | W. | Clear morning and cloudy afternoon and |
| 22 | ,74 | ,63 | 65 | 69 | 78 | 60 | W. | Clear. [wind inclining to S. W. |
| 23 | ,67 | ,60 | 67 | 71 | 80,5 | 55 | W. | Clear. |
| 24 | ,69 | ,61 | 66 | 71 | 79 | 56 | W. | Clear. |
| 25 | ,75 | ,66 | 66 | 70 | 79 | 56 | W. | Clear. |
| 26 | ,71 | ,60 | 67 | 73 | 81 | 58 | W. | Clear, and strong wind. |
| 27 | ,68 | ,60 | 67 | 72 | 81 | 54 | W. | Clear, and strong wind. |
| 28 | ,73 | ,60 | 66,5 | 72 | 80,5 | 57 | W. | Clear. |

## 2.—Indian Arts and Manufactures.

### *Glazed Pottery.*

In an essay, published in the *Transactions of the Society of Arts,* by Mr. A. Aikin, occur the following speculations on the origin of the art of glazing earthen-ware, which he traces to China, and allows no higher a period of antiquity than the thirteenth century. That the art however was known in early ages to the Egyptians is proved by the frequent discovery of porcelain figures, enamelled or glazed in various colors, and it seems curious that this circumstance should not have been noticed by the author. Glazed tiles were certainly much used in ornamenting tombs and mosques by the Mohammedan conquerors of India, as most of our readers have had opportunities of seeing, in the Upper Provinces, and it would be worth while, in illustration of Mr. Aikin's remarks, to ascertain the age of the most conspicuous *dargáhs* of this nature.

" The ancient Greeks appear to have been wholly unacquainted with the art of covering earthen-ware with a vitreous glaze ; at least neither Pliny nor other authors say any thing on the subject, nor am I aware that any specimens of glazed ancient Greek or Roman pottery exist. For heating water and other liquids in, metallic vessels were generally employed : and for cold liquids, the natural porousness of the ware was corrected by a varnish of wax or resin, which may be seen on all the so-called Etruscan vases.

"Vitreous glazes, whether employed simply for closing the pores of baked clay, and thus rendering it impermeable to water, or with the further intention of concealing the coarseness and bad colour of the body by a covering of enamel, appear to have originated in China; for the earliest European travellers in that country make mention of temples covered and encrusted by varnished tiles of various colours.

"The invasion and conquest of China by ZENGHIS KHAN, in 1312, was probably the event that made known to the rest of Asia and to Europe the art of glazing earthen-ware. The empire of ZENGHIS extended from China across the Steppes or pastoral regions of Asia to the Caucasus, between the Black Sea and the Caspian, and his son OCTAI pushed through Russia into Poland and the confines of Germany. They likewise, in their victorious progress, held hostile or friendly intercourse with many of the Mohammedan sovereigns who possessed the countries to the south and west of them; and the whole Mohammedan world, though broken into independent, and frequently conflicting states, was nevertheless pressed into close union by the crusades, which had hardly yet subsided, and by the now imminent danger of Tartar conquest. The Moslems were also at this time not only a warlike but an active, ingenious, splendid, and inquisitive people, possessing a language, the Arabic, in a great measure common to all who professed the faith of Mohammed. The similarity of their architecture, in the wide extent of country from the Ganges to Gibraltar, shews not only a coincidence of feeling but a community of intercourse. It appears therefore to me by no means improbable, that an invention, which was largely and generally applied to decorative purposes in Mohammedan architecture, should have travelled in a few years from the confines of China to Spain.

"The palace of the Moorish kings at Granada, called *Alhambra*, was built in 1280, and many of the rooms are represented as ornamented by lacquered tiles. The tomb of SULTAN MAHOMMED KHODA-BENDEH, at *Sultánieh*, in Persia, was also built in the thirteenth century: and of this the cupola and minarets are still in many parts covered with a green lacquered tile, and the great architrave is formed of a dark-blue one.

"In 1475 was built the painted *masjid* in the now ruined city of *Gaur*, in India: it derived its name from the profusion of glazed tiles with which it was ornamented; specimens of which are preserved in the East-India Museum.

"The mother of SHAH ABBAS, about 1550, built a caravanserai at *Mayar*, near *Isfahán*, the front gate of which is inlaid with green tiles: and at present the domes of the mosques of that city are covered with green and blue tiles.

"MARCO POLO, the Venetian, visited in 1270 the Court of KUBLAI KHAN, the grandson of ZENGHIS, and remained in the employ of that sovereign for several years; at the same time, merchants from many of the commercial cities of Italy were travelling for the purpose of trade, in most of the countries between Syria and India. By some of these the art of covering baked earthen-ware with an opaque vitreous glaze might be imported into Italy; and Florence and its territory soon became celebrated for the fine works executed on plates of this ware, which met with a ready sale throughout Europe. The name given in France to these works was *faience*, supposed to have been derived from *Faenza*, a village near Florence, or perhaps the word is a mere corruption of *Firenze*, the Italian name of that city, TIRABOSCHI mentions one "LUCA DELLA ROBBIA, a Florentine, born in 1388, who appears to have been the first who made figures of terra cotta and covered them with a varnish, to preserve them from the injuries of time and weather. He also adorned flat surfaces of terra cotta with various colours, and painted figures on them, by which he rendered himself so famous that he received orders for them from all parts of Europe."

However early the introduction of the art of glazing tiles in India may have been, it is certain that as regards vessels for holding liquors, it was little used, or at least that it has since become obsolete. Enamelling with various glazes on metal is still practised with great success up the country, but to common cheap pottery this branch of the art would be inapplicable. We have seen in Dr. Wise's Description of the Hooghly Ice Manufacture (vol. ii. page 80), that the cheap earthen dishes are only rendered impervious to water by smearing their interior with grease, or wax, as was customary in Spain and Italy, in olden times, and is even so in the present day. The clay of which the common earthen-ware is made in Bengal is of so fusible a nature that it would not stand the heat necessary for the application of what is called stone-glaze, made by the vapours of salt at an intense heat, and metallic glazes are too expensive for so cheap a commodity; still there are many cases in which it is most desirable to teach the native potters how to perform this useful process, and we therefore extract Mr. Aikin's short account of the various methods of glazing now in use in England. The *Khari-matti* or porcelain clay of the *Rajmahl* and *Vindya* hills has been applied to the manufacture of stone-ware bottles for soda-water, by Dr. J. Jeffreys, at *Farakhábád*, with perfect success; and this, being infusible, is capable of receiving the salt glaze, as described below, of the Vauxhall manufacture.

"I shall now proceed to give a brief account of the manufacture of the common red pottery ware as practised in the neighbourhood of London, and in various other parts of the kingdom; for the principal particulars of which, as well as for the specimens in illustration of it, I am indebted to Mr. Jones, of Lambeth. The material is a yellowish brown clay, from Deptford, there being no other near London on which the glaze will spread with the equality that is required. In general the clay is used without any addition; but such parcels as are too fat or tenacious are brought to a proper state by mixture with loam. The clay is watered and turned, but not being an alluvial clay, contains no stones, and therefore, does not require to be washed over. It is finally passed through the pug-mill in order to temper it. The required form of a pot or pan, or any other article, is given to it on the wheel, and the ware is dried under cover till it has acquired a considerable solidity. The glaze is then put on in the state of cream, by means of a brush, care being taken to cover the whole surface as evenly as possible: for small articles such as pipkins, that are glazed only internally, a little of the cream is poured in and then poured out again, a sufficient quantity of the glaze adhering to the surface of the ware.

"The materials of the glaze are galena, commonly called potter's lead-ore, ground to an impalpable powder, and then mixed with clay diffused in water, technically called slip. This glaze is transparent, and of a pale yellow colour, and consequently shews through it the colour of the ware; if a black opaque glaze is required, one part of common manganese is added to nine parts of galena. After the glaze is laid on, the ware is again dried, and is then piled in the kiln in order to be burnt or fired. For the first twenty-four hours a very low heat is applied, in order to drive all the moisture out of the ware; it is then exposed for twenty-four hours more to a heat as high as it can bear without fusion, which has the effect of baking the clay, of driving off the sulphur from the lead-ore, and of causing the oxide of lead to form a frit or imperfect glass with the clay, the other ingredient of the glaze. The fire is now fed with bavin-wood instead of coal, by which the heat is increased, the furnace is filled with flame, and the frit being converted into a perfect glass, flows uniformly over the surface of the ware. The fire is then allowed to go out, and when the furnace has become cool, the contents are removed. If the air has been still during the burning, and due care has been observed, the articles in every part of the kiln will be properly baked; but a high wind always renders the heat very unequal, so that the ware in the windward part of the kiln will not be baked enough, while that in the leeward part will be over-burnt and run to a slag.

"All articles of earthen-ware which after being baked are opaque, are more or less porous; and if a heat somewhat approaching to their point of fusion, so as to render them slightly translucent, cannot safely be applied, it is evident that such ware is not very proper for vessels employed in cookery, and for several other purposes, from the difficulty of keeping them clean, and from their liability to crack when set on the fire in a damp state. In England, we endeavour to obviate this imperfection by means of a thick vitreous glaze; but as the ware itself is very fusible, the glaze must be still more so; and as oxide of lead forms the cheapest and most fusible glaze, this accordingly is the material universally employed by us. But there is a very serious objection to the use of this glaze, namely, that it is soluble in vinegar, in the juice of most fruits, especially when hot, and also in boiling fat; the consequence of which is, that the food of the lower classes, by whom alone cooking vessels of glazed red-ware are employed, is often contaminated with lead, so as seriously to impair their health by occasioning colics, and the other usual effects of lead poison. Possibly borax, which is now a cheap article and is very fusible, might be made to supersede the use of lead; if not, the only way of avoiding this very serious hazard to health, will be the use of more refractory clay, which, consequently, would allow the employment of a less fusible glaze free from lead. This has been done by Mr. Meigh, a potter in Staffordshire, to whom the Society awarded a medal for his invention; the ware produced by him is far superior to that in common use, and well deserves the encouragement of the public. A species of ware, somewhat superior to our common red-ware, is made at Lambeth, of Maidstone clay, being of a paler colour and a more compact texture than the latter, but does not take a uniform covering by the common glaze for red-ware; it is therefore chiefly used for purposes which admit its employment in an unglazed state, or in situations where the imperfection of the glaze is not perceived, as in ornamented chimney-pots, gas-consumers, &c.

"A more perfect, and indeed very excellent species of earthen-ware, is that called stone-ware, originally introduced from Holland, and now made in several parts of the kingdom, and especially at Lambeth. To one of the principal manufacturers of this ware, Mr. Wisker, I am indebted for the following particulars:

"The materials are, pipe-clay from Dorsetshire and Devonshire, calcined and ground flint from Staffordshire, and sand from Woolwich and Charlton.

"The clay is pulverized and sifted dry, and is either used alone, when an article of great compactness is required, as soda-water bottles, or is mixed with sand to diminish its contraction in the fire. For retorts and other large vessels, instead of sand, the refuse stone-ware, ground to a fine powder, is used. For the finer articles, such as figured jugs, ground flint is employed in place of sand. The composition is brought by the addition of water, to the state of mortar, and is then tempered in the pug-mill. All round articles are made on the horizontal wheel; and those of great size, *i. e.* of a greater capacity than two gallons, are at first of extraordinary thickness below to support the upper part; when they come off the wheel they are dried, and then put on the wheel again, and shaved down to a proper thickness. For oval, and other figures not circular, as pans for salting hams in, the clay is formed in a mould to the required shape. The drying, especially of large articles, must be very carefully performed; and as, from custom, the tops or bottoms of jars and various other vessels made of this ware, are required to be of a deeper brown than the natural colour of the materials, they are dipped in a mixture of red-ochre and clay slip. When perfectly dry they are piled in the furnace, bits of well-sanded clay being put between each piece to prevent them from adhering. A slow fire is kept up for twelve to twenty-four hours, according to the thickness of the ware, capable of bringing it just to a low red heat. The fire is then to be raised till the flame and the ware are of the same colour, and is so to be continued for several hours. At this time the glaze is added, which is done by pouring down the holes in the top of the kiln, twenty or thirty in number, ladlesful of common salt. This, being volatilized by the intense heat of the interior, attaches itself to the outer surface of the ware: here it is decomposed, the muriatic acid flying off, and the soda remaining behind in union with the earth, with which it forms a very thin, but, on the whole, a perfect glaze; at least quite sufficient, with the compactness of the ware, to render it completely proof against the percolation, not only of water, but of the strongest acids. So perfect, indeed, is the texture of the best ware now made, that it has of late been very largely used in the construction of distillatory vessels for manufacturing chemists, instead of green glass, as being more durable and also cheaper. Pickling jars, and many other vessels in which acid substances for food or condiment are kept, as also those earthen vessels in which great strength is required, are best made of stoneware. Vauxhall is the chief seat of this manufacture. There are now about eight houses engaged in this fabric, most of which are very actively employed, as the use of it is considerably on the increase."

In the porcelain of China, so justly celebrated for its beauty and excellence, the glaze is produced by a wash of clay of a kind more fusible than that of the body of the ware.

Three materials are known to be employed in this manufacture. 1. *Petuntse,* which is quarried from certain rocks and contains shining particles: (mica ?) the lumps of this clay are broken up and ground in iron mortars, then lixiviated, and the creamy matter only used. Mr. Aikin supposes it to be a compact felspar; perhaps it may be a decomposing granite, from which the felspar is thus coarsely separated. 2. *Kaolin,* true porcelain clay, or decomposed felspar found in lumps in the clefts of mountains, covered with a reddish earth (just as it occurs in India). It is prepared for use like the *petuntse.* 3. *Hoaché,* which has a soapy feel, and is either steatite soapstone, or agalmatolite. It is also prepared in the same way, but is whiter, more transparent, and is used only for the more expensive wares.

For the finest porcelain, four parts of *hoaché* are added to one of *petuntse.* Sometimes the body is made of *kaolin,* dipped when dry into the cream of *hoaché,* which gives a white coat. *Hoaché* is also laid on with a pencil on the parts intended to have an ivory-white colour.

" The white semi-transparent glaze is thus prepared. The whitest *petuntse* with green spots is pulverized and washed over; to 100 parts of the cream thus obtained is added one part of *che-kao* (burnt alum) previously pulverized. A caustic ley is also prepared into which *che-kao* is stirred, and the cream thus produced is collected. The two creams are mixed together in the proportion of ten measures of the former to one of the latter, and this composition, washed over the dry unbaked ware, gives it its whiteness and lustre. A brown glaze is made of common yellow clay added to the above. The Chinese porcelain is never brought to the state of biscuit, by a prior baking, before it is glazed.

" The flux used with colours laid on the glaze is made of one part calcined quartz and two parts ceruse. Red is given by peroxide of iron, and a finer red by copper, but the process is not known. The enamel colours are brought to a proper consistence by a solution of glue, except those containing ceruse, which can only be tempered with water*."

3.—*Phenomenon of the Japanese Mirror.*

The Philosophical Magazine of Dec. 1832 contains Sir D. Brewster's explanation of the magical effect of the mirror, of which a notice was published by myself in vol. 1. p. 242.

Sir David had only received a written description from Mr. G. Swinton, and therefore it was hardly fair to expect him to give a categorical reply to that gentleman's question, " how are these strange effects produced?" After alluding however to Mr. Swinton's conjecture that the phenomena may originate in a difference of density in different parts of the metal, occasioned by the stamping of the figures on the back, which, if metals were absolutely opaque, and if the lights they reflect never entered their substance, would, he says, be the only possible way in which the stamped figures could be reflected,—the learned Doctor proceeds to offer his own theory.

" I believe, however, on the authority of the phenomena of elliptical polarization, that in silver nearly one-half of the reflected light has entered the metal, and in other metals a less portion. So that we may consider the surface of every metal as transparent to a certain depth, a fact which is also proved by the transparency of gold and silver leaf. Now this thin film having its parts of variable density, in consequence of the stamping of the figure, might reproduce the figure by reflection. It is well known that silver *polished by hammering* acts differently upon light from silver that has received a *specular polish;* and I have elsewhere† expressed the opinion that a parabolic reflector of silvered copper, polished by hammering, will from the difference of density of different parts of the reflecting film, produce at the distance of many miles a perceptible scattering of the reflected rays, similar to what takes place in a transparent fluid or solid, or gaseous medium. I am satisfied, however, that at the distance of a few inches from the Chinese mirror, this evanescent effect will be altogether imperceptible, and that we must seek for another cause of the phenomenon under consideration.

" Some years ago I had occasion to observe the light of the sun reflected upon paper from a new and highly polished gilt button, and I made a drawing at the time of the figure, which appeared in the spectrum. It consisted of radiations exactly like the spokes of a carriage wheel, the radiations being *sixteen* in number, and a little confused in the centre opposite the eye of the button. On the back of this button several words were deeply stamped, but these words did not appear in the reflected image.

* *Trans.* Soc. Arts and Repository of Inventions. † Ed. Trans. vol. xi. p. 47.

I have since examined several varieties of such buttons, and I find that they almost all give either radiations or great numbers of narrow concentric rings, (and sometimes both,) whose centre is the centre of the button, and the smallest one of which is always like a dimple in the centre.

"Upon examining the surface of these buttons in the sun's light, and at the edge of a shadow*, I have invariably been able to see the same rings excavated in the polished face that appeared in the luminous image, which it reflected. They obviously arise from the button being finished in a turning lathe, and the rings are produced by the action of the polishing powder, or probably in some cases they may be the grooves of the turning tool, which have not been obliterated by the subsequent processes†.

"These facts will, I presume, furnish us with the secret of the Chinese mirror. Like all other conjurors, the artist has contrived to make the observer deceive himself. The stamped figures on the back are used for this purpose. The spectrum in the luminous area *is not an image of the figures on the back.* The figures are a copy of the picture which the artist *has drawn on the face of the mirror*, and so concealed by polishing that it is invisible in ordinary lights, and can be brought out only in the sun's rays.

"Let it be required, for example, to produce the dragon described by Mr. Swinton as exhibited on one of these Chinese mirrors. When the surface of the mirror is ready for polishing, the figure of the dragon may be delineated upon it in extremely shallow lines, or it may be eaten out by an acid much diluted, so as to remove the smallest possible portion of the metal.

"The surface must then be highly polished, not upon pitch, like glass and specula, because this would polish away the figure, but upon cloth, in the way that lenses are sometimes polished. In this way the sunk part of the hollow lines will be as highly polished as the rest, and the figure will only be visible in very strong lights, by reflecting the sun's rays from the metallic surface. When the space occupied by the figure is covered by lines or by etching, the figure will appear *in shade* on the wall, and vice versâ."

In spite of the overwhelming authority opposed to me, I feel reluctant to give up the theory I ventured to advance, in explanation of the anomaly in question, and I am emboldened to maintain it by the simple fact, that Sir David had not yet seen the mirror: indeed in this respect we stand an equal ground;—the mirror was gone from Calcutta *before* I had attempted to solve its nature: it had not arrived when Dr. Brewster offered his ingenious theory. The best arguments which I can advance in favor of my own are—1, that the mirror underwent several rude processes of polishing in Calcutta, so much so, that most of its *silvered surface* was worn off, and yet its reflective faculties were unimpaired. 2, no signs of engraving were observed on the surface, under the strongest horizontally reflected light, which ought to have shewn its presence as explained, by Sir David.

Dr. Brewster's theory cannot fail however to win converts: it would be presumption in me to go farther in opposing it, than to request a suspension of judgment until the mirror shall have arrived in England; meanwhile its magical powers must continue, as he says, "to perplex the philosophers of our eastern metropolis!"

* "By this method the figure in the Chinese mirror could be rendered visible *beneath its polish.*"

† "In polished *steel* buttons the reflected light is crowded with lines running at right angles, indicating the cross strokes by which they have been ground and polished."

*Meteorological Register kept at the Assay Office, Calcutta, for the month of April, 1833.*

| Day of the month. | Barometer reduced to 32° Farh. At 5 A. M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Thermometer in the Air. Minimum at 5 A. M. | At 10 A. M. | Max. by reg. Ther. | At 4 P. M. | At 10 P. M. | Depression of moist-bulb Thermometer. At 5 A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | Hair Hygrometer. At 10 A. M. | At 4 P. M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ,835 | ,862 | ,783 | ,808 | 77,2 | 85,5 | 95,8 | 91,4 | 79,2 | 2,7 | 6,6 | 14,5 | 4,2 | 91 | 75 | | s. | S. | S. | scud. | hazy. | hazy. |
| 2 | ,890 | ,851 | ,695 | ,872 | 79, | 86, | 96, | 92,0 | 80,1 | 2,8 | 6,5 | 8,5 | 3,7 | 91 | 87 | | s. | S. | S. | clear. | clear. | do |
| 3 | ,787 | ,801 | ,656 | ,709 | 76,8 | 85,6 | 99,2 | 93,8 | 80,2 | 1,8 | 6,0 | 11,7 | 3,0 | 92 | 80 | | S. | S. | S. | do | do | do |
| 4 | ,653 | ,707 | ,577 | ,657 | 78,1 | 88,6 | 96,8 | 92, | 80,2 | 3,3 | 6,7 | 8,3 | 3,6 | 91 | 88 | | S. | S. | S. | do | do | do |
| 5 | ,645 | ,775 | ,668 | ,738 | 77, | 88,0 | 1025 | 92,4 | 82,3 | 2,2 | 7,5 | 16,7 | 5,4 | 90 | 67 | | S. | S. | S. | do | do | heavyscud |
| 6 | ,671 | ,784 | ,675 | ,752 | 79, | 87,4 | 92,4 | 91,8 | 81,5 | 1,8 | 6,2 | 8,6 | 4,3 | 92 | 88 | | s. | S. | S. | cloud | do | clear. |
| 7 | ,720 | ,820 | ,682 | ,815 | 80,2 | 87,6 | 101, | 92, | 82,3 | 3,2 | 6,2 | 10,0 | 5,8 | 92 | 80 | | S. | s. | s. | cum. | do | hazy. |
| 8 | ,814 | ,861 | ,690 | ,780 | 78,7 | 88, | 101, | 92,0 | 80, | 2,5 | 6,3 | 13,6 | 4,8 | 91 | 74 | | o. | o. | s. | clear. | do | s.wd.*a* ngt. |
| 9 | ,743 | ,822 | ,660 | ,720 | 79, | 87,2 | 97, | 91,8 | 80, | 3,6 | 7,4 | 14,6 | 5,0 | 91 | 76 | | s. | s. | s. | do | do | clear. |
| 10 | ,696 | ,733 | ,620 | ,709 | 78,6 | 87,0 | 95, | 92,6 | 79,7 | 4,6 | 7,3 | 11,4 | 5,7 | 90 | 83 | | S. | s. | S. | do | do | do |
| 11 | ,675 | ,790 | ,640 | ,701 | 77, | 86,6 | 93,4 | 90,4 | 80,7 | 3,9 | 7,2 | 11,0 | 5,0 | 90 | 84 | | S. | S. | S. | cum. | hazy. | do |
| 12 | ,654 | ,765 | ,670 | ,755 | 79, | 87,7 | 95,2 | 90,8 | 75,3 | 3,3 | 7,0 | 9,0 | 5,2 | 90 | 86 | 1.40 | S. | S. | s. e. | scud. | do | n.w.*a* 8 rn. |
| 13 | ,750 | ,808 | ,733 | ,819 | 74,5 | 86,4 | 93, | 83,7 | 71, | 4,5 | 5,0 | 6,8 | 2,8 | 94 | 89 | 1.55 | s E. | s. e. | w. e. | rain | v. w. | n. at3pmcl |
| 14 | ,762 | ,830 | ,720 | ,842 | 74,2 | 85, | 91, | 87, | 77,2 | 3,8 | 5,1 | 8,0 | 6,6 | 94 | 87 | | s. | o. | n. e. | cloudy | fair | stratus. |
| 15 | ,800 | ,852 | ,710 | ,784 | 74,3 | 83,5 | 92, | 89,8 | 79,8 | 3,0 | 5,2 | 10,1 | 3,0 | 95 | 86 | | n. | s. e. | s. | cumuli. | clear. | nwr. rain. |
| 16 | ,756 | ,800 | ,668 | ,793 | 77,8 | 85,5 | 92,2 | 88,7 | 83, | 3,6 | 4,8 | 7,5 | 5,6 | 94 | 90 | 0.17 | s. | s. | s. | do | do | s. gatherg. |
| 17 | ,682 | ,737 | ,637 | ,697 | 74,4 | 85,4 | 90, | 88,7 | 81, | 3,3 | 5,0 | 6,8 | 3,8 | 93 | 92 | | s. | s. | S. | clear | do | cumuli. |
| 18 | ,684 | ,721 | ,595 | ,698 | 80, | 86,3 | 93, | 90,7 | 83,5 | 3,6 | 5,0 | 6,5 | 5,1 | 92 | 92 | | S. | s. | S. | cum str. | do | clear. |
| 19 | ,603 | ,647 | ,525 | ,602 | 81,1 | 88, | 98, | 90,5 | 81, | 1,9 | 5,4 | 6,5 | 4,0 | 93 | 92 | | S. | S. | S. E. | clear | stm. gat. | dgy squal. |
| 20 | ,587 | ,705 | ,595 | ,647 | 82,2 | 88, | 95, | 92,0 | 82, | 4,0 | 5,2 | 10,0 | 4,2 | 94 | 85 | | S. | S. | S. | cumuli | clears. | clear. |
| 21 | ,537 | ,720 | ,630 | ,684 | 80,4 | 90,2 | 98, | 93, | 82, | 2,5 | 5,4 | 12,0 | 3,4 | 94 | 80 | | o. | s. | s. w. | clear | do | do |
| 22 | ,646 | ,747 | ,650 | ,741 | 80, | 88, | 102, | 92,5 | 83,3 | 2,5 | 5,7 | 14,6 | 5,0 | 93 | 75 | | s. w. | s. | s. w. | do | cumuli. | do |
| 23 | ,692 | ,776 | ,670 | ,725 | 80, | 90,2 | 103, | 94,1 | 82,1 | 2,0 | 5,7 | 13,5 | 3,3 | 94 | 81 | | w. | s. | S. | scud s. | do | do |
| 24 | ,671 | ,730 | ,626 | ,635 | 79,8 | 90, | 1045 | 94,6 | 83,3 | 1,8 | 8,0 | 15,4 | 5,8 | 89 | 75 | | s. | s. | S. | clear | clear. | do |
| 25 | ,595 | ,614 | ,571 | ,618 | 81,5 | 89,5 | 104, | 93,7 | 81, | 3,9 | 7,4 | 18,0 | 2,4 | 90 | 69 | | s. w. | s. | s. | cumuli | cum. | do |
| 26 | ,597 | ,712 | ,638 | ,678 | 80, | 90,2 | 99,4 | 93,8 | 84,2 | 3,0 | 7,5 | 10,5 | 5,6 | 90 | 81 | | s. | s. | S. | cirri. | do | bank s. e. |
| 27 | ,627 | ,730 | ,587 | ,650 | 82, | 88,8 | 1008 | 93,6 | 81, | 4,1 | 6,0 | 10,4 | 4,0 | 92 | 86 | 0.40 | S. | s. | E. | cumuli. | gath. rn. | clear. |
| 28 | ,646 | ,740 | ,620 | ,684 | 81, | 88,7 | 1018 | 93,5 | 82,2 | 3,0 | 6,2 | 10,3 | 3,0 | 91 | 86 | | s.w. | o. | S. | clear | clear. | do |
| 29 | ,665 | ,746 | ,642 | ,700 | 80, | 88,7 | 95,6 | 93,3 | 83,2 | 1,8 | 6,3 | 10,2 | 5,2 | 90 | 85 | | s. | w. | S. | do | do | scud. |
| 30 | ,676 | ,744 | ,640 | ,710 | 81,7 | 88,5 | 97, | 93,4 | 83,0 | 4,6 | 7,0 | 10,2 | 4,6 | 91 | 85 | | s. | S. | S. | do | clouds. | |
| Means, | ,692 | ,765 | ,650 | ,699 | 78,8 | 87,5 | 97,2 | 1,6 | 80,8 | 2,8 | 6,2 | 10,8 | 4,4 | 92 | 83 | 3.52 | south monsoon. | | | frequent storms. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory, and the Sunday entries are filled in by interpolation. The instruments for 5 A. M. and 10 P. M. are observed daily in the south veranda of a house near the Cathedral. The Barometer for 10 A. M. and 4 P. M. stood during March on an average .042 lower than that at the surveyor general's office, but as the daily differences vary from +.007 to—.083 when even the indications of the latter are reduced to the freezing point, it is impossible to reconcile them. The force of wind is represented by the size of the type used.

# JOURNAL

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## I.—*Origin and Classification of the Military Tribes of Népál. By* B. H. Hodgson, *Esq.*

[Read at the Meeting of the 9th January, 1833.]

The great aboriginal stock of the inhabitants of these mountains, east of the river *Káli*, or in *Népál*, is *Mongol*. The fact is inscribed, in characters so plain, upon their faces, forms, and languages, that we may well dispense with the superfluous and vain attempt to trace it historically in the meagre chronicles of barbarians.

But from the 12th century downwards, the tide of *Mussulmán* conquest and bigotry continued to sweep multitudes of the *Brahmans* of the plains from *Hindústán* into the proximate hills, which now compose the western territories of the kingdom of *Népál*. There the *Brahmans* soon located themselves. They found the natives illiterate, and without faith, but fierce and proud.

Their object was to make them converts to *Hindúism*, and so to confirm the fleeting influence derived from their learning and politeness. They saw that the barbarians had vacant minds, ready to receive their doctrines, but spirits not apt to stoop to degradation ; and they acted accordingly. To the earliest and most distinguished of their converts they communicated, in defiance of the creed they taught, the lofty rank and honors of the *Kshatriya* order. But the *Brahmans* had sensual passions to gratify, as well as ambition. They found the native females—even the most distinguished—nothing loath; but still of a temper, like that of the males, prompt to repel indignities. These females would, indeed, welcome the polished *Brahmans* to their embraces : but their offspring must not be stigmatised as the infamous progeny of a *Brahman* and a *Mléchha*—must, on the contrary, be raised to eminence in the new order of things introduced by their fathers. To this progeny also, then, the *Brahmans,* in still greater defiance of their creed, communicated the rank of the second order of *Hindúism;* and from these two roots, mainly, sprung the now numerous, predominant, and extensively ramified, tribe of the *Khás*—originally the name of a small clan of creedless barbarians, now the proud title of the *Kshatriya,* or military order of the kingdom of *Népál.* The offspring of original *Khás* females and of *Brahmans,* with the honors and rank of the second order of *Hindúism,* got the patronymic titles of the first order; and hence the key to the anomalous nomenclature of so many stirpes of the military tribes of *Népál* is to be sought in the nomenclature of the sacred order. It may be added, as remarkably illustrative of the lofty spirit of the *Parbattiahs,* that, in spite of the yearly increasing sway of *Hindúism* in *Népál,* and of the various attempts of the *Brahmans* in high office, to procure the abolition of a custom so radically opposed to the creed both parties now profess, the *Khás* still insist that the fruit of commerce (marriage is out of the question) between their females and males of the sacred order shall be ranked as *Kshatriyas,* wear the thread, and assume the patronymic title.

The original *Khás,* thus favored by it, became soon and entirely devoted to the *Brahmanical* system*. The progress of *Islám* below daily poured fresh refugees among them.

They availed themselves of the superior knowledge of the strangers to subdue the neighbouring tribes of aborigines, were successful beyond their hopes, and, in such a career continued for ages, gradually merged the greater part of their own habits, ideas, and language (but not physiognomy) in those of the *Hindús.*

The *Khás* language became a corrupt dialect of *Hindí,* retaining not many palpable traces (except to curious eyes) of primitive barbarism.

The *Ekthariahs* are the descendants more or less pure of *Rájpúts* and other *Kshatriyas* of the plains, who sought refuge in these mountains from the *Moslem,* or, merely military service as adventurers. With fewer aims of policy and readier means in their bright swords of requiting the protection afforded them than had the *Brahmans,* they

* That is, they agreed to put away their old gods, and to take the new; to have *Brahmans* for *Gúrús;* and not to kill the cow: for the rest, they made and still make sufficiently lightly of the ceremonial law in whatever respects food and sexual gratification. Their active habits and vigorous character could not brook the restraints of the ritual law; and they had the example of licentious *Brahmans* to warrant their neglect of it. The few prejudices of the *Khás* are useful rather than otherwise, inasmuch as they favour sobriety and cleanliness.

had less motive to mix their proud blood with that of the vile aborigines than the *Brahmans* felt the impulse of, and they did mix it less. Hence, to this hour, they claim a vague superiority over the *Khás*, notwithstanding that the pressure of the great tide of events around them has, long since, confounded the two races in all essentials. Those among the *Kshatriyas* of the plains, who were more lax, and allied themselves with the *Khás* females in concubinage, were permitted to give to their children, so begotten, the patronymic title only, not the rank. But their children again, if they married for two generations into the *Khás*, became pure *Khás*, or, real *Kshatriyas* in point of privilege and rank, though no longer so in name! They were *Khás*, not *Kshatriyas*: and yet they bore the proud cognomina of the martial order of the *Hindús*, and were, in the land of their nativity, entitled to every prerogative which *Kshatriya* birth confers in *Hindústán!*

Such is the third and less fruitful root of the *Khás* race.

The *Ekthariahs* speak the *Khás* language, and they speak no other.

The *Thákurís* differ from the *Ekthariahs* only by the accidental circumstance of their lineage being royal. At some former period, and in some little state or other, their progenitors were princes.

The *Sahí* are the present royal family.

The remaining military tribes of the *Parbattiahs* are the *Magar* and *Gúrúng*, who now supply the greater numbers of the soldiers of this state.

From lending themselves less early and heartily to *Brahmanical* influence than the *Khás* they have retained, in vivid freshness, their original languages, physiognomy, and, in a less degree, habits.

To their own untaught ears their languages differ entirely the one from the other, but, in very truth, only as remote dialects of one great tongue, the type of which is the language of Tibet. Their physiognomies, too, have peculiarities proper to each, but with the general *Calmuk* caste and character in both. The *Gúrúngs* are less generally and more recently redeemed from *Lámáism* and primitive impurity than the *Magars*.

But, though both *Gúrúngs* and *Magars* still maintain their own vernacular tongues, Tartar faces, and careless manners, yet, what with military service for several generations, under the predominant *Khás*, and what with the commerce of *Khás* males with their females*, they

* Here, as in the cases of the *Brahman* and *Khás*, and *Kshatriya* and *Khás*, there can be no marriage. The offspring of a *Khás* with a *Magarin* or *Gúrúngni* is a titular *Khás* and real *Magar* or *Gúrúng*. The descendants fall into the rank of their mothers, and retain only the patronymic.

have acquired the *Khás* language, though not to the oblivion of their own; and the *Khás* habits and sentiments, but with sundry reservations in favor of pristine liberty. As they have, however, with such grace as they could muster, submitted themselves to the ceremonial law of purity, and to *Brahman* supremacy, they have been adopted as *Hindús*. But partly owing to the licenses above glanced at, and partly by reason of the necessity of distinctions of caste to *Hindúism*, they have been denied the thread, and constituted a doubtful order below it, and yet not *Vaisya* nor *Sudra*, but a something superior to both the latter, what, I fancy, it might puzzle the *Shástrís* to explain on *Hindú* principles.

The *Brahmans* of *Népál* are much less generally addicted to arms than those of the plains; and they do not therefore properly belong to our present subject. The enumeration of the *Brahmans* is nevertheless necessary, as serving to elucidate the lineage and connexions of the military tribes, and especially of the *Khás*.

The martial classes of *Népál* are, then, the *Khás*, *Magar*, and *Gúrúng;* each comprising a very numerous clan or race, variously ramified and subdivided in the manner exhibited in the following tabular statement.

The original seat of the *Khás* is ordinarily said to be *Gorkhá*, because it was thence immediately that they issued, 70 years ago, under the guidance of PRITHVI NARAYAN, to acquire the fame and dominion achieved by him and his successors of the *Gorkháli* dynasty.

But the *Khás* were long previously to the age of PRITHVI NARAYAN extensively spread over the whole of the *Choubísya;* and they are now found in every part of the existing kingdom of *Népál*. The *Khás* are rather more devoted to the house of *Gorkhá*, as well as more liable to *Brahmanical* prejudices than the *Magars* or *Gúrúngs;* and, on both accounts, are somewhat less desirable as soldiers for our service than the latter tribes. I say somewhat, because it is a mere question of degree; the *Khás* having, certainly, no religious prejudices, nor probably any national partialities, which would prevent their making excellent and faithful servants in arms; and they possess pre-eminently that masculine energy of character and love of enterprize which distinguish so advantageously all the military races of *Népál*. The original seat of the *Magars* is the *Bára Mangránth, or Satahung, Payung, Bhirkot, Dhor, Garahung, Rising, Ghiring, Gúlmi, Argha, Khachi, Musikot, and Isma;* in other words, most of the central and lower parts of the mountains between the *Bhéri* and *Marsyándi** rivers.

* The *Marichangdi* of our maps.

The attachment of the *Magars* to the house of *Gorkhá* is but recent, and of no extraordinary or intimate nature. Still less so is that of the *Gúrúngs*, whose native seats occupy a line of country parallel to that of the *Magars*, to the north of it, and extending to the snows in that direction. Modern events have spread the *Magars* and *Gúrúngs* over most part of the present kingdom of *Népál*. The *Gúrúngs* and *Magars* are, in the main, *Hindús, only because it is the fashion;* and the *Hindúism* of the *Khás*, in all practical and soldierly respects, is free of disqualifying punctilio.

These highland soldiers, who despatch their meal in half an hour, and satisfy the ceremonial law by merely washing their hands and face, and taking off their turbans before cooking, laugh at the pharisaical rigor of our *sipáhís*, who must bathe from head to foot, and make *púja*, ere they begin to dress their dinner, must eat nearly naked in the coldest weather, and cannot be in marching trim again in less than three hours.

In war, the former readily carry several days provisions on their backs: the latter would deem such an act intolerably degrading. The former see in foreign service nothing but the prospect of glory and spoil: the latter can discover in it nothing but pollution and peril from unclean men and terrible wizards, goblins, and evil spirits. In masses, the former have all that indomitable confidence, each in all, which grows out of national integrity and success: the latter can have no idea of this sentiment, which maintains the union and resolution of multitudes in peril, better than all other human bonds whatever.

I calculate that there are at this time in *Nipal* no less than 30,000 *Dákhriahs*, or soldiers off the roll by rotation, belonging to the above three tribes. I am not sure that there exists any insuperable obstacle to our obtaining, in one form or other, the services of a large body of these men; and such are their energy of character, love of enterprise and freedom from the shackles of caste, that I am well assured their services, if obtained, would soon come to be most highly prized.

In my humble opinion they are by far the best soldiers in India; and if they were made participators of our renown in arms, I conceive that their gallant spirit and unadulterated military habits might be relied on for fidelity; and that our good and regular pay and noble pension establishment would serve to counterpoise the influence of nationality, especially in the *Magars* and *Gúrúngs*.

The following table exhibits a classified view of the *Brahmanical* and Military tribes, with their various subdivisions.

## *Tabular View of the Tribes.*

### Brahmans.

| | | | |
|---|---|---|---|
| Arjâl. | Rupâkhêti. | Osti. | Dhurâri. |
| Pondyâl. | Khativâra. | Utkûlli. | Bhúrtyâl. |
| Khanâl. | Dhakâl. | Kandariah. | Panêrü. |
| Rêgmi. | Adhikâri. | Ghart mêl. | Loityâl. |
| Bhattrâi. | Deoja. | Ghartyâl. | Sigdhyâl. |
| Nirôla. | Rukâi. | Nivapânya. | Barâl. |
| Achârya. | Sywâl. | Têmrâkoti. | Gotamya. |
| Bhatt. | Rijâl. | Uphaltopi. | Ghorasaini. |
| Sâpan kotya. | Dhúngyâl. | Parijai Kavala. | Risyâl. |
| Maharâshtra. | Loiyâl. | Homya Gâi. | Châlîsya. |
| Kôirâla. | Dotiyâl. | Champa Gâi. | Dhôngâna. |
| Pakonyâl. | Kandyâl. | Gûra Gâi. | Bharâri. |
| Sattyâl. | Katyâl. | Subêri. | Bâgalya. |
| Dohâl. | Dangâl. | Pandit. | Dulâl. |
| Lamsâl. | Singyâl. | Têva pânya. | Parajuli. |
| Rimâl. | Bikrâl. | Timil Sina. | Bajgâi. |
| Dêvakotya. | Ukniyâl. | Kâphalya. | Satôla. |
| Parbatya Vash. | Bhattwâl. | Gaithoula. | Ghúrchôli. |
| Parbatya Misr. | Gajniyâl. | Gairaha Pipli. | Kêlathoni. |
| Davâri. | Chavala Gâi. | Ghimirya. | Gîlal. |
| Koikyâl. | Vasta Gâi. | Simkhâra. | Lahôni. |
| Nepâlya. | Banjâra. | Phúnwâl. | Muthbari. |
| Barâl. | Dâgi. | Chamka saini. | |
| Pokaryâl. | Sôti. | Pùra saini. | |

### Khas.

*1st. Subdivision of the Khás, called Thâpa.*

| | | | |
|---|---|---|---|
| Bagyâl. | Gâgliyâ. | Powâr. | Khapotari. |
| Takuryâl. | Suyâl. | Ghimirya. | Parâjuli. |
| Palâmi. | Maharâji. | Khulâl. | Deoja. |
| Gûdâr. | Lâmichanya. | Sunyâl. | |

*2nd. Subdivision of the Khás, called Bishnyát.*

| | | | |
|---|---|---|---|
| Khulâl. | Khaputari. | Sripâli. | Puwâr. |

*3rd. Subdivision, called Bhandári.*

| | | |
|---|---|---|
| Raghubansi. | Lâma. | Sijapati. |

*4th. Subdivision, called Kárki.*

| | | |
|---|---|---|
| Sutâr. | Lâma. | Mûndala. | Khûlâl. |

*5th. Subdivision, called Khangká.*

| | | | |
|---|---|---|---|
| Powâr. | Maharâji. | Partyâl. | Khaputari. |
| Lakânggi. | Lâmichanya. | Khulâl. | Palpâli. |
| Kâlikotya. | | | |

*6th. Subdivision,* or *Adhikari.*

| | | | |
|---|---|---|---|
| Thâmi. | Tharirâi. | Pokriyâl. | Musiah. |
| Dhâmi. | Khadhsêna. | Thâkûri. | |

*7th. Subdivision,* or *Bisht.*

| | |
|---|---|
| Kâlikotya. | Puwâr. |

*8th. Subdivision,* or *Kunwár.*

| | | |
|---|---|---|
| Bagâlya. | Khulâl. | Khangka. | Arjâl. |

*9th. Subdivision,* or *Bâniah.*

Sijapati.

*10th. Subdivision,* or *Dâni.*

| | |
|---|---|
| Sijapati. | Powâr. |

*11th. Subdivision,* or *Gharti.*

| | |
|---|---|
| Kalikotya. | Sijapati. |

*12th. Subdivision,* or *Khattri.*

| | | | |
|---|---|---|---|
| Pândé. | Khulâl. | Lâmichânya. | Arjâl. |
| Tewâri. | Suvêri. | Dhakâl. | Sâpkotya. |
| Panth. | Poryâl. | Phanyâl. | |
| Adhikâri. | Sakhtyâl. | Burâl. | |

*True Khas not yet classified.*

| | | | |
|---|---|---|---|
| Dhongyâl. | Sijâl. | Satouya. | Rûpakhêti. |
| Loyâl. | Chouvala Gâi. | Parsâi. | Khatiwata. |
| Lamsâl. | Am Gâi. | Chalatâni. | Bhatt Râi. |
| Khukriyâl, | Baj Gâi. | Kilathoni. | Neopânya. |
| Dangâl. | Satya Gâi. | Muri Bhûs. | Dahâl. |
| Sikhmiyâl. | Devakota. | Alphâltopi. | Sôti. |
| Bhiryâl. | Garhtôla. | Parijâi Kawala. | Osti. |
| Pouryâl. | Sêôra. | Bamankotya. | Bhatt Ojha. |
| Bikrâl. | Bâlya. | Tewâri. | Kadariah. |
| Kanhâl. | Gilâl. | Porsêni. | Kâla Khattri. |
| Batyâl. | Chonial. | Homya Gâi. | Dhûngâna. |
| Ganjâl. | Rêgmi. | Tûmrakot. | Pungyâl. |

Ektharya, or *insulated tribes ranking with Khás.*

| | | | |
|---|---|---|---|
| Bûrathoki. | Chohan. | Bohara. | Kutâl. |
| Râya. | Boghati. | Chiloti. | Dikshit. |
| Ravat. | Khatit. | Dângi. | Pandit. |
| Katwâl. | Sâvan. | Raimanjhi. | Parsâi. |
| Khàti. | Mahat. | Bhukhandi. | Chokhâl. |
| Maghati. | Barwâl. | Bhusâl. | Chohara. |
| | | | Durrah. |

Thakuri, or *Royal lineages, ranking with Khás.*

| | | | |
|---|---|---|---|
| Sâhi. | Singh. | Chand. | Jiva. |
| Malla. | Maun. | Hamâl. | Rakhsya. |
| Sêna. | Chohan. | Ruchâl. | |

## Magars.

I.—*Subdivision of the Magars, called Rână.*

| | | | |
|---|---|---|---|
| Bhusâl. | Gyângmi. | Byângnâsi. | Kyâpchâki. |
| Aslâmi. | Pulâmi. | Phyûyâli. | Durra Lâmi. |
| Yahâyo. | Gâcha. | Lâmichânya. | Mâski. |
| Sârû. | Pusâl. | Gandharma. | Charmi. |
| Arghounlé. | Thâda. | Dûtt. | |

II.—*Subdivision of Magars, called Thâpa.*

| | | | |
|---|---|---|---|
| Grânjâ. | Chumi. | Kêli. | Barêya. |
| Namjâli. | Lûngêli. | Jhângdi. | Mâski. |
| Darrlâmi. | Sunâri. | Yângdi. | Phyûyâli. |
| Marsyângdi. | Chitouriah. | Jhâri. | Arghounlé. |
| Gelâng. | Sinjali. | Sârû. | Rijâl. |

III.—*Subdivision of Magars, called Alaya.*

| | | | |
|---|---|---|---|
| Yângmi. | Sarângi. | Pûng. | Lamjâl. |
| Sûrya Vansi. | Gônda. | Sripâli. | Sûyâl. |
| Khâli. | Dukhchâki. | Sijapati. | Panthi. |

| | | | |
|---|---|---|---|
| Thokchâki. | Mêng. | Gharti. | Rakhâl. |
| Sithûng. | Maski. | Lâmichânya. | Palâmi. |
| Lahakpâ. | Arghounlé. | Khaptari. | Phyûyâli. |
| Kyapchâki. | Dûrrâ. | Khulâl. | Chermi. |
| Pachâin. | | | |

GURUNGS.

| | | | |
|---|---|---|---|
| Gúrûng. | Lâmichânya. | Khaptari. | Tangé. |
| Ghallé. | Siddh. | Ghûndâné. | Ghônyâ. |
| Byâpri. | Karâmati. | Dhârên. | Paindi. |
| Vumjan. | Gôsti. | Jimêl. | Mêngí. |
| Lâma. | Bagâlya. | Lopâté. | Dah Lâma. |
| Thâthûng. | Chandú. | Lothâng. | Kurângi. |
| Gôthi. | Chârki. | Bûlûng. | Khulâl. |
| Gondûk. | Khâti. | Shakya Lâma. | Surya Vansi Lama. |
| Gohori. | Guâburi. | Golângya. | Madân. |
| Barâhi. | Pengi. | Khangva. | Palâmi. |
| Ghârti. | Dhakarên. | | |

## II.—*Description of Bokhára. By Lieut.* A. Burnes, *Bombay Army, Asst. Resident at Kutch.*

Our first care on entering *Bokhára* was to change our garb, and adopt the usages prescribed by the laws of the country. A petition to the minister might have perhaps relieved us of the necessity, but to do so was in consonance with our own plans, and we did not delay a moment in fulfilling them. Our turbans were exchanged for shabby sheep-skin caps with the fur inside, and our *kamarbands* were thrown aside for a rude piece of rope or tape. The outer garment of the country was discontinued, as well as our stockings, since these are the emblems of distinction in the holy city of *Bokhára* between an infidel and a true believer. We know also that none but a Muhammedan might ride within the walls of the city, and we had an inward feeling which told us to be heartily gratified if we were permitted, at such trifling sacrifices, to continue our abode in the capital. A couplet* which describes *Samarcand* as the paradise of the world, also names *Bokhára* as the strength of religion and of *Islám*; and impious and powerless as we were, we could have no desire to try experiments among those who seemed, outwardly, at least, such bigots. The dress which I have described is nowhere enjoined by the *Qorán,* nor did it obtain in these countries for two centuries after the prophet; not till the bigotry of

* سمرقند صیقل روی زمین است
بخارا قوّت اسلام و دین است

some of the Khaliphs discovered that the faithful should be distinguished from those who were not Muhammedans.

On entering the city, the authorities did not even search us, but in the afternoon an officer summoned us to the presence of the minister. My fellow-traveller was yet prostrated by fever, and could not accompany me; I therefore proceeded alone to the ark or palace where the minister lived along with the king. I was lost in amazement at the novel scene before me, since we had to walk for about two miles through the streets of *Bokhára* before reaching the palace. I was immediately introduced to the minister, or as he is styled, the *Gosh Bègí*, an elderly man, of great influence, who was sitting in a small room, with a private court-yard in front of it. He desired me to be seated outside on the pavement, but evinced both a kind and considerate manner, which set my mind at ease. The hardness of my seat, and the distance from the minister, did not overpower me with grief, since his son, who appeared during the interview, was even further removed than myself. I presented a silver watch and a *Kashmír* dress, which I had brought for him; but he declined to receive anything, saying that he was but the slave of the king. He then interrogated me for about two hours, regarding my own affairs and the objects which had brought me to a country so remote as *Bokhára*. I told the usual tale of being in progress towards our native country, and produced my passport from the Governor General of India, which the minister read with peculiar attention. I then added, that *Bokhára* was a country of such celebrity among eastern nations, that I had been chiefly induced to visit *Turkistán* for the purpose of seeing it. But what is your profession, said the minister? I replied that I was an officer of the Indian army. But tell me, said he, something about your knowledge:—and he here entered upon various topics as to the customs and politics of Europe, but particularly of Russia, on which he was well informed. In reply to his inquiries regarding our baggage, I considered it prudent to acquaint him that I had a sextant, since I concluded that we should be searched, and it was better to make a merit of necessity. I informed him therefore that I liked to observe the stars, and the other heavenly bodies, since it was a most attractive study. On hearing this, the vizier's attention was roused, and he begged, with some earnestness, and in a subdued tone of voice, that I would inform him of a favorable conjunction of the planets, and the price of grain which it indicated in the ensuing year. I told him, that our astronomical knowledge did not lead to such information; at which he expressed himself disappointed. On the whole, however, he appeared to be satisfied of my character, and assured me of protection while in *Bokhára;* he however prohibited our using pen and ink, since it might lead to our conduct being misrepresented to the king, and prove injurious. He also added, that the route to the Caspian Sea by the way of *Khíva* had been closed for the last year; and that, if we intended to enter Russia, we must either pursue the northern route from *Bokhára,* or cross the *Túrkmán* desert below *Organj* to *Astrabád* on the Caspian.

Two days after this interview, I was again summoned by the vizier, and found him surrounded by a great number of respectable persons, to whom he appeared desirous of exhibiting me. I was questioned in such a way as to make me believe that our character was not altogether free from suspicion; but the vizier said jestingly, I suppose you have been writing about *Bokhára.* Since I had in the first instance given so true a tale, I had here no apprehensions of contradiction, and freely told the party that I had come to see the world, and the wonders of *Bokhára,* and that by the vizier's favor, I had been already perambulating the city. The minister was the only person who appeared pleased with the candour, and said that he would be happy to see me at all times in the evening: he inquired if I had any curiosity to exhibit to him, either of India or my own country; but I regretted my inability to meet his wishes. On my return home, it occurred to me that the all-curious vizier might be gratified by the sight of a patent compass, with its glasses, screws, and reflectors; but I also feared that he might construe my possession of this complicated piece of mechanism into a light which would not be favorable. I however sallied forth with the instrument in my pocket, and soon found myself in the presence of the vizier. I told him that I believed I had found a curiosity that would gratify him, and produced the compass, which was quite new and of very beautiful workmanship. I described its utility, and pointed out its beauty, till the vizier seemed quite to have forgotten, "that he was but a slave of the king, and could receive nothing;" indeed he was proceeding to bargain for its price, when I interrupted him. I assured him that I had brought it from *Hindústán,* that I might purposely present it to him; since I had heard of his zeal in the cause of religion, and it would enable him to point to the holy Mecca, and rectify the *Kibla* of the grand mosque, which he was now building in *Bokhára.* I told him, that I could receive no reward, since we were already rewarded, above all price, by his protection. The *Gosh Bègí* packed up the compass with all the haste and anxiety of a child, and said that he would take it direct to his Majesty, and describe the wonderful ingenuity of our nation. Thus fell one of my compasses. It was a fine instrument, by Schmalcalder, but I had a duplicate, and I think it was not sacrificed without an ample return. Had we been in *Bokhára* in disguise, and personating some assumed character, our feelings would have been very different from what they now were. Like owls, we should only have appeared at night; but after this incident, we stalked abroad in the noon-tide sun, and visited all parts of the city.

My usual resort in the evening was the *Régistan* of *Bokhára,* which is the name given to a spacious area of the city near the palace, that opens upon it. In two other sides there are massive buildings, colleges of the learned; and on the fourth stands a fountain filled with water, and shaded by lofty trees, where idlers and newsmongers congregrate around the wares of Asia and Europe, which are here exposed for sale. A stranger has only to seat himself on a bench of the *Régistan,* to know the *Uzbèks* and the people of *Bokhára.* He may here converse with the natives of Persia, Turkey, Russia, Tartary, China, India, and *Kabúl.* He will meet with *Túrkmáns, Calmuks,* and *Kuzzaks,* from the surrounding deserts, as well as the natives of the more favoured lands. He may contrast the polished manners of the subjects "of the great King" with the ruder habits of a roaming Tartar. He may see the *Uzbèks* from all the states of *Máwarulnahr,* and speculate from their physiognomy on the changes which time and place effect among any race of men. The *Uzbèk* of *Bokhára* is hardly to be recognized as a *Turk* or Tartar, from his intermixture of Persian blood. Those from the neighbouring country of *Kokan* are less changed, and the natives of *Organj,* the ancient *Kharasm,* have yet a harshness of feature peculiar to themselves; they may be distinguished from all others by dark sheep-skin caps, about a foot high. A red beard, grey eyes, and fair skin will now and then arrest the notice of a stranger, and his attention will have been fixed on a poor Russian, who has lost his country and his liberty, and here drags out a miserable life of slavery. A native of the Celestial Empire will be seen here and there in the same forlorn predicament, shorn of his long cue of hair, with his crown under a turban, since both he and the Russian act the part of Muhammedans. Then follows a Hindú, in a garb foreign to himself and his country: a small square cap, and a string, instead of a girdle, distinguishes him from the Muhammedans, and, as the Moslems themselves tell you, prevents their profaning the prescribed salutations of their language, by using them to an idolator. Without these distinctions, the native of India is to be recognized by his sombre look, and the studious manner in which he avoids all communication with the crowd. He herds only with a few individuals, similarly circumstanced with himself. The

Jew is as marked a being as the *Hindú;* his costume differs from the follower of Brahma, and a small conical cap marks the children of Israel. No mark however is so distinguishing as the well known features of the Hebrew people. In *Bokhára* they are a race remarkably handsome, and I saw more than one Rebecca in my peregrinations. Their features are set off by ringlets of beautiful hair, which hang over their cheeks and necks. There are about 4000 Jews in *Bokhára,* originally from *Meshid* in Persia. They are chiefly employed in dyeing cloth. They receive the same treatment as the *Hindús.* A strayed Armenian, in a still different dress, represents that wandering nation; but there are few of them in *Bokhára.* With these exceptions, the stranger beholds in the bazars a portly, fair, and well-dressed mass of people, the Muhammedans of *Túrkistán.* A large white turban, and a *chogha* or pelisse of some dark colour over three or four other of the same description is the general costume; but the *Régistan* leads to the palace, and the *Uzbèks* delight to appear before their King in a mottled garment of silk, called "*adras,*" which is of all and the brightest colours, and would be intolerable to any but an *Uzbèk.* Some of the higher persons are clothed in brocade, and one may distinguish the gradations of the chiefs, since those in favour ride into the citadel, and the others dismount at the gate. Almost every individual who visits the King is attended by his slave; and though this class of people are for the most part Persians, or their descendants, they have a peculiar appearance. It is said, indeed, that three-fourths of the people of *Bokhára* are of slave extraction, for of the captives brought from Persia, into *Túrkistán,* few are permitted to return, and, by all accounts, there are many who have no inclination to do so. A great portion of the people of *Bokhára* appear on horseback. Whether mounted or on foot, they are dressed in boots, and the pedestrians strut on high and small heels on which it would puzzle a *Corinthian* to walk or even stand. They rise about an inch and a half, and the pinnacle is not one-third the diameter. This is the national dress of the *Uzbèk.* Some men of rank have a shoe over the boot, which is taken off on entering a room. I must not forget the ladies in my enumeration of the inhabitants. They generally appear on horseback, riding as the men; a few walk, and all are veiled with a black hair-cloth napkin. The difficulty of seeing through it makes the fair ones stare at every one as in a masquerade. There however no one must speak to them, and, if any of the King's harem pass, you are admonished to look in another direction, and get a punch on the head if you infringe the advice. So holy are the fair ones of the holy *Bokhára.*

My reader will have now become familiar with the appearance of the inhabitants of *Bokhára.* From morn to night, the crowd which assembles raises a humming noise, and one is stunned at the moving mass of human beings. In the middle of the area, the fruits of the season are sold under the shade of a square piece of mat, supported by a single pole. One wonders at the never-ending employment of the fruiterers in dealing out their grapes, melons, apricots, apples, peaches, pears, and plums; for the continued succession of purchasers proves that the tide of men still flows. With difficulty a passage can be forced through the streets, and it is only done at the momentary risk of being run over by some one on the back of a horse or an ass. These latter animals are exceedingly common and very fine, they amble along at a quick pace with their riders and burthens. Carts of a light construction are also driving up and down, since the nature of the country, and the streets which are not too narrow, admit of wheeled carriages in all parts of the bazar. Everywhere are seen people making tea, which is done in large European urns instead of tea-pots, and kept hot by a metal tube. The penchant of the *Bokharís* for tea is, I believe, without parallel; for they drink it at all times and places, and in half a dozen ways, with and without sugar, with and without milk, with grease, with salt, &c. Next to the venders of this hot beverage, one may purchase "rahet-i jan," or the delight of life, grape jelly or syrup mixed up with chopped ice. The abundance of ice is one of the greatest luxuries in *Bokhára,* and it may be had till the cold weather makes it unnecessary. It is pitted in winter, and sold so cheap that it is within the reach of the poorest people. No one ever thinks of drinking water without icing it, and a beggar may be seen purchasing it as he proclaims his poverty and entreats the bounty of the passenger. It is a nice and refreshing sight to see the huge masses of it with the thermometer at 90°, coloured, scraped, and piled into heaps like snow to tickle the *Uzbèks'* palate. It would be endless to describe the whole body of traders: suffice it to say, that almost every thing may be purchased in the *Régistan;* the jewellery and cutlery of Europe (coarse enough however), the tea of China, the sugar of India, the spices of Manilla, &c. &c. One may also add to his stores of learning, both *Túrkí* and Persian, at the book-stalls, where the learned or would-be-so pore over tattered pages at a hawker's board. As one withdraws in the evening from this bustling crowd to the more retired parts of the city, he treads his way through arched bazars, now empty, and passes mosques surmounted by handsome cupolas, and adorned by all the simple ornaments which are admitted by Muhammedans. After the bazar hours, these are crowded for evening prayers. At the doors of the colleges, which generally face the mosques, one may see the students lounging after the labours of the day, not however so gay or so young as the tyros of an European university, but many of them grave and demure old men, with more hypocrisy, but by no means less vice, than their youthful prototypes in another quarter of the world. These people however are stained by vices which there find no shelter even among the most depraved libertines. With the twilight this busy scene closes, the King's drum beats, it is re-echoed by others in every part of the city, and at a certain hour no one is permitted to move out without a lantern. From these arrangements, the police of the city is excellent, and in every street large bales of cloth are left on the stalls at night in perfect safety. All is silence till the morn, when the bustle again commences in the *Régistan,* the busy hive of men. The day is ushered in with the same guzzling and tea-drinking, and hundreds of boys and donkeys laden with milk hasten to the busy throng. The milk is sold in small bowls, over which the cream floats: a lad will bring twenty or thirty of these to market, in shelves supported and suspended by a stick over his shoulder. Whatever number may be brought, speedily disappear among the tea-drinking population of this great city.

Soon after our arrival, I paid a visit to our late travelling companions, the tea merchants, who had taken up their abode in a caravansery, and were busy in unpacking, appraising, and selling their tea. They sent to the bazar for ice and apricots, which we sat down and enjoyed together. One of the purchasers took me for a tea merchant from the society I was in, and asked for my investment. The request afforded both the merchants and myself some amusement, but they did not undeceive the man on my mercantile character, and we continued to converse together. He spoke of the news of the day, the late conquests of the king at *Shahr Sabz,* and of the threats of the Persians to attack *Bokhára,* all without his ever suspecting me to be ought but an Asiatic. In return, we had visits from these merchants, and many other persons who principally came to gratify their curiosity. We were not permitted to write, and it was an agreeable manner of passing our time, since they were very communicative. The *Uzbèks* are a simple people, with whom one gets most readily acquainted: they speak in a curious tone of voice, as if they despised, or were angry with, you.

They never saluted us by any of the forms among Muhammedans, but appeared to have another set of expressions, the most common of which is, "May your wealth increase" *(doulat zyáda).* They nevertheless always said the "*fathaa*" or blessing from the *Qorán*, stretching out their hands and stroking down their beards before they sat down. Many of our visitors betrayed suspicions of our character, but still evinced no unwillingness to converse on all points, from the politics of their king to the state of their markets. Simple people, they believe a spy must measure their forts and walls, they have no idea of the value of conversation. With such ready returns on the part of our guests, it was not irksome for me to explain the usages of Europe; but let me advise a traveller to lay in a good stock of that kind of knowledge, before he ventures to travel in eastern countries. One must have a smattering of trade, arts, science, religion, medicine, and, in fact, of every thing; and any answer is better than a negative, since ignorance, real or pretended, is construed into wilful concealment.

I took an early opportunity of seeing the slave bazar of *Bokhára,* which is held every Saturday morning. The *Uzbĕks* manage all their affairs by means of slaves, who are chiefly brought from Persia by the Túrkmans. These poor wretches are here exposed for sale, and occupy thirty or forty stalls, where they are examined like cattle, only with this difference, that they are able to give an account of themselves vivâ voce. On the morning which I visited the bazar, there were only six unfortunate beings, and I witnessed the manner in which they are disposed of. They are first interrogated regarding their parentage and capture, and if they are Muhammedans, that is, *Sunnís*. The question is put in that form, for the *Uzbĕks* do not consider a *Shiah* to be a true believer, since with them, as with the primitive Christians, a sectary is more odious than an unbeliever. After the intended purchaser is satisfied of the slave's being an infidel (*kaffir*), he examines his body, particularly noting if he be free from leprosy, so common in *Túrkistán,* and he then proceeds to bargain for his price. Three of the Persian boys were for sale at thirty tillas of gold a piece*, and it was surprising to see how contented the poor fellows sat under their lot. I heard one of them telling how he had been seized south of *Meshid,* while tending his flock; another, who overheard a conversation among the bystanders regarding the scarcity of slaves that season, stated that a great number had been taken. His companion said with some feeling, You and I only think so, because of our own misfortune; but these people must know better. There was one unfortunate girl, but she had been long in service, and was now being sold by her master because of his poverty. I felt that many a tear had been shed in the court where I surveyed the scene, but I was assured from every

* 200 Rupees.

quarter that slaves are well treated and well fed, and the circumstance of so many of them remaining in the country after they have been manumitted seems to establish this fact. The bazars of *Bokhára* are chiefly supplied from *Organj*. Russians and Chinese are also sold but rarely. The feelings of an European revolt at this odious traffic; but the *Uzbeks* entertain no such notions, and believe that they are conferring a benefit on a Persian when they purchase him, in hopes that he may renounce his heretical opinions.

From the slave-market I passed on that morning to the great bazar, and the very first sight which fell under my notice was the offenders against Muhammedanism of the preceding Friday. They consisted of four individuals, who had been caught asleep at prayer time, and a youth who had been seen smoking in public. They were all tied to each other, and the tobacco-lover led the way, holding his *hooka* or pipe in his hand. The officer of police followed with a thick thong, and chastised them as he went, calling aloud, "Ye followers of Islam, behold the punishment of those who violate the law!" Never however was there such a series of contradiction and absurdity as in the practice and theory of religion in *Bokhára.* You may openly purchase tobacco, and all the most approved paraphernalia for inhaling its narcotic qualities; yet if seen smoking in public you are straightway dragged before the Qazi, punished by stripes, or paraded on a donkey with a blackened face, while the innocent hooka hangs before you as a warning to others. If a person is caught flying pigeons on a Friday, he is sent forth with the dead bird round his neck, seated on a camel. If seen in the streets at the time of prayers, and convicted of such habitual neglect, fines and imprisonment follow; yet there are bands of the most abominable wretches who frequent the streets in the evening, and encourage the violation of the *Qoran*. The laws of the Faithful punish this offence with death, but the Commander of the Faithful (the King is so called) sets an example to his subjects, and follows the customs of his fore-fathers. Every thing indeed presents a tissue of contradictions, and none were more apparent to me than the punishment of these culprits, who were marching with all the pomp of publicity, by the very gate way of the court, where human beings were levelled with the brutes of the earth, *no doubt* against the laws of humanity, but *as certainly* against the laws of Muhammed.

The *Hindús* of *Bokhára* sought our society with great avidity, for that people seem always to look upon the English as their superiors. They visited us in every country we passed, and would never speak any other language than *Hindústaní*, which seemed a bond of union between us and them. In this country they appear to enjoy a sufficient degree of toleration to enable them to live happily. An enumeration of their restrictions might make them appear a persecuted race. They are not permitted to build temples, set up idols, or walk in procession; they do not ride within the walls of the city, and must wear a peculiar dress. They pay the *jizzya,* or capitation tax, which varies from four to eight rupees a year; but this they only render in common with others, not Muhammedans. They must never abuse or ill use a Muhammedan. When the King passes their quarter of the city, they must draw up and wish him health and prosperity. When on horseback outside the city, they must dismount if they meet His Majesty, or the *Qazí.* They are not permitted to purchase female slaves, as an infidel would defile a believer; nor do any of them bring their families beyond the Oxus. For these sacrifices, the *Hindús* in *Bokhára* live unmolested, and in all trials and suits have equal justice with the Muhammedans. I could hear of no forcible instance of conversion to *Islám,* though three or four individuals had changed their creed in as many years. The deportment of these people is most sober and orderly: one would imagine that the tribe had renounced laughter, if he judged by the gravity of their countenances. They themselves however speak highly of their privileges, and are satisfied at the celerity with which they can realize money, though it be at the sacrifice of their prejudices. There are about three hundred *Hindús* in *Bokhára,* and they live in a caravansery of their own. They are chiefly natives of *Shikárpúr,* in *Sinde,* and their number is on the increase. The *Uzbeks* and indeed all the Muhammedans find themselves vanquished by the industry of these people, who will stake the largest sums of money for the smallest gain.

Among the *Hindús* we had a singular visitor in a deserter from the Indian Army at Bombay! He had set out on a pilgrimage to all the shrines of the *Hindú* world, and was then proceeding to the fire temples on the shores of the Caspian. I knew many of the officers of the Regiment (the 24th N. I.) to which he had belonged, and felt pleased at hearing names which were familiar to me in this remote city. I listened with interest to the man's detail of his adventures and travels, nor was he deterred by any fear that I would *lodge information* against him and secure his apprehension. looked upon him as a brother in arms, and he amused me with many a tale of our friend Murad Beg of *Kúndúz,* whom he had served as a bombardier, and followed in his campaigns. This man, when he first shewed himself, was disguised in the dress of a pilgrim; but the carriage of a soldier is not to be mistaken, though he has traversed the mountains and deserts to *Bokhára.*

The house in which we lodged was exceedingly small, and overlooked on every side; but we could not regret it, since it presented an opportunity of seeing a *Túrkí* beauty, a most handsome young lady, who promenaded one of the surrounding balconies, and *wished to think* she was not seen. A pretended flight was not even neglected by this fair one, whose curiosity often prompted her to steal a glance at the *Firingís.* Since we had a fair exchange, she was any thing but an intruder, though unfortunately too distant for us to indulge in the sweet "music of speech." The ladies of *Bokhára* stain their teeth quite black, they plait their hair and allow it to hang in tresses down their shoulders. Their dress differs little from the men; they wear the same pelisses, only that the two sleeves, instead of being used as such, are tucked together and tied behind. In the house even they dress in large Hessian boots, made of velvet and highly ornamented. What a strange taste for those who are eternally concealed, to choose to be thus booted as if prepared for a journey. On the head they wear large white turbans, but a veil covers the face, and many a lovely countenance wastes its fragrance beneath this netting. The exhibition of beauty, in which so much of a woman's time is spent in more favored countries, is here unknown. A man may shoot his neighbour, if he sees him on a balcony at any but a stated hour. Assassination follows suspicion. The laws of the *Qorán* regarding the sex are here most strictly enforced.

In my travels through *Cabúl* I had often enjoyed the luxuries of the bath, according to the custom of the Orientals. I now had the same pleasure in *Bokhára,* but it was only admissable in some buildings, since the priests had asserted that the water of certain baths would change into blood if polluted by a woman or an infidel! A bath is too well known to require a description, but the operation is really most singular, You are stretched out like a fish, rubbed with a hair brush, scrubbed, buffetted and kicked about, but it is still very refreshing. The baths of *Bokhára* are most spacious. They are constructed on the plan of a panoptagon, many smaller domes surrounding a great one, and heated to different temperatures. In the day time the light is admitted from coloured glasses over the large dome, in the night a single lamp under it suffices for all the cells. The portion of the circle towards *Mecca* is appropriated as a mosque, where the luxurious Muhammedan may offer up his orisons while he is enjoying one of the promised blessings of his prophet's paradise. There are eighteen baths in *Bokhára*, one or two are of very large dimensions; but the generality of them bring in an annual income of 150 *tillas* (1000 Rupees). This is a calculation which may serve to number the inhabitants. Each individual pays to the keeper of the bath ten pieces of brass money, of which there are 135 in a rupee. About an hundred people may therefore bathe for a *tilla*, and 150 *tillas* will give 15,000 people to each bath. Eighteen baths will give a total of 2,700,000, who enjoy the luxury yearly. But the baths are only used during the cold months, and some of the poorer people are never able to afford the expense.

I did not omit to pay my respects to the minister while I rambled about the city, and Dr. Gerard in the course of ten days was sufficiently recovered to accompany me. The Vizier was equally inquisitive with the Nawab at *Cabúl* regarding the manufacture of medicines and plasters, and the Doctor endeavoured to meet his wishes. We had however got into a more civilized region on our approach to Europe, since the Vizier had received quinine and other medicines from Constantinople. We sat with the minister, while he was transacting business, and saw him levy his duties on the merchants, who were never more liberally treated in any country. The webs of cloth are produced, and every fortieth piece is taken in place of duties. This gives the merchant his profits, nor distresses him for ready-money. A Muhammedan indeed has only to take the name of the prophet, stroke down his beard, and declare himself poor, to be relieved from *all* duties. One man said he had witnesses to prove his being in debt, and would produce them. The minister replied, Give us your oath, we want no witnesses: he gave it, every one called out "God is great," and said the "*fátaha*," on which the goods were returned without an iota of charge. With every disposition to judge favourably of the Asiatics, (and my opinions regarding them improved, as I knew them better,) I have not found them free from falsehood: I fear, therefore, that many a false oath is taken among them. No people could be more liberal encouragers of commerce than the rulers of *Bokhára*. During the reign of the last monarch the duties on goods were never paid till they were sold, as in the bonding system of a British custom-house. The Vizier on this occasion conversed at great length on subjects of commerce relating to *Bokhára* and Britain, and expressed much anxiety to increase the communication between the countries, requesting that I myself would return to *Bokhára*, and not forget to bring a good pair of spectacles for his use. Our intercourse was now established on a footing which promised well: I took occasion therefore to express a wish to the Vizier of paying my homage to the King. I had touched on a tender point, for it appeared that the minister had feared our being charged with some proposals to His Majesty, which we concealed from himself. "I am as good as the *Amír*," (so the King is called,) said he, "and if you have no matters of business to transact with the king, what have travellers to do with courts?" I told him of our curiosity on these points, but he did not choose that we should have the honor, and that was sufficient for abandoning the suit.

I was nevertheless resolved to have a sight of Royalty, and at mid-day on the following Friday repaired to the great mosque, a building of Timourlane, and saw His Majesty and his court passing from prayers. The King appears to be under thirty years of age, and has not a prepossessing countenance; his eyes are small, his visage gaunt and pale. He was plainly dressed in a silken robe of "*udrus*," with a white turban. He sometimes wears an aigrette of feathers, ornamented with diamonds. The *Qorán* was carried in front of him, and he was preceded and followed by two golden mace-bearers, who exclaimed in Turkish, "Pray to God that the Commander of the Faithful may act justly!" His suite did not exceed an hundred people; most of them were dressed in robes of Russian brocade, and wore gold ornamented swords—I should call them knives, the mark of honor in this country. His present Majesty has more state than any of his predecessors; but he may consider it necessary to affect humility in a temple, and in returning from a religious ceremony. The people drew up by the way side as he passed, and with a stroke of their beards wished His Majesty peace; I did the same. The character of this King, Bahadur Khan, stands high among his countrymen; at his elevation to the throne, he distributed all his wealth. He is strict in his religious observances, and less bigotted than his father Mir Hyder. He acts according to the *Qorán* in all cases, and it is pretended that he even lives on the capitation tax which is levied from the Jews and *Hindús*.

The revenues of the country are said to be spent in maintaining *mullahs* and mosques; but this young King is ambitious and warlike, and I believe that it is therefore more probable he turns his treasure to the increase of his power.

The life of this King is less enviable than that of most private men. The water which he drinks is brought in skins from the river, under the charge and seal of two officers. It is opened by the Vizier, and first tasted by his people, and then by himself, when it is again sealed and dispatched to the King. The daily victuals of His Majesty undergo a like examination: the minister eats, he gives to those around him, they wait the lapse of an hour to judge of their effect, when they are locked up in a box and dispatched! His Majesty has one key and his minister another. Fruit, sweetmeats, and every eatable undergo the same examination, and we shall hardly suppose the good King of the *Uzběks* ever enjoys a hot meal or a fresh-cooked dinner. Poison is in frequent request, as we may judge by the homely occupations of a minister of state. The rise of His Majesty himself to the throne he now holds is not however without strong suspicion of a free distribution of such draughts; but the detail of those events belongs to another portion of my subject.

I expressed a wish soon after reaching *Bokhára* to see some of the unfortunate Russians who have been sold into this country. One evening, a stout and manly looking person fell at my feet and kissed them. He was a Russian of the name of Gregory Pulukoff, who had been kidnapped when asleep at an outpost, about twenty-five years ago; he was the son of a soldier, and now followed the trade of a carpenter. I made him sit down with us, and give an account of his woes and condition. It was our dinner time, and the poor carpenter helped us to eat our pilao. Though but ten years of age when captured, he yet retained his native language, and the most ardent love to return to his country. He paid seven tillas a year to his master, who allowed him to practise his trade, and keep all he might earn beyond that sum. He had a wife and child, also slaves. "I am well treated by my master," said he, "I go where I chose, I associate with the people and personify the part of a Muhammedan, I appear happy, but my heart burns for my native land, where I would serve in the most despotic army with gladness. Could I but see it again, I would willingly die. I tell you my feelings, but I smother them from the *Uzběks*. I am yet a Christian, (here the poor fellow crossed himself after the manner of the Greek Church,) and I live among a people who detest with the utmost cordiality every individual of that creed. It is only for my own peace that I call myself a Muhammedan." The poor fellow had acquired all the habits and manners of an *Uzběk*, nor should I have been able to distinguish him but for his blue eyes, red beard, and fairer skin. He inquired of me with much earnestness if there were any hopes of him and his comrades being released; but I could give him no further news than the floating rumours which I had heard of the Emperor's intention to suppress the traffic by an army. He told me that the last embassy to *Bokhára* under M. Negri had failed to effect that desired end, but that the sale of Russians had ceased in *Bokhára* for the last ten years. There were not at present 130 natives of Russia in the kingdom.

The whole of those in *Bokhára* would have been released by the Ambassador, had not some religious discussion arisen on the propriety of allowing Christians who had become Muhammedans to relapse into their idolatry! The *mullahs* had seen the pictures in the Greek Church, and no argument will reverse what they state to be the evidence of their senses, that the Russians worship idols. There is generally some difference of opinion on all points, and that of the Russians and *Bokhárís* on the subject of slavery was much at variance. The Muhammedans are not sensible of any offence in enslaving the Russians, since they state that Russia herself exhibits the example of a whole country of slaves, and particularly in the despotic government of her soldiery. "If we purchase Russians," say they, "the Russians buy the *Kazzaks* on our frontier. We are Muhammedans, and they tamper with these people by threats, bribery, and hopes to make them forsake their creed and become idolators. Look, on the other hand, at the Russians in *Bokhára*, at their liberty, comfort, and toleration, and compare it with the black bread and unrelenting tyranny which they experience in their native country, and which has on some occasions driven them voluntarily to us." We shall not attempt to decide between the parties, but it is a melancholy reflection on the liberties of Russia, that they admit of a comparison with the institutions of a Tartar kingdom, whose pity, it is said, is only upon a par with the tyranny of the *Afghan*.

With Russians, *Hindús*, and *Uzbeks*, our circle of acquaintance at *Bokhára* soon increased, and most of the *Afghan* and *Cabúl* merchants sought our society, and we could not but feel gratified at the favorable opinion entertained by them of the British in India. One of them, Sirwar Khan, a Lohanee merchant of great opulence, to whom we were never introduced, offered us any money we might require, and did it in a manner that left no doubt of his sincerity. We were assailed by him and his countrymen, and even by *Uzbeks*, to give notes of hand, certifying our acquaintance with them; for the *Afghans* believe the hand-writing to be a bond of union between Englishmen, and that the possession of it secures them an honorable reception in India. We complied with the wishes of those who deserved our confidence. Among our other friends was a *Cashmír* merchant, who wished me much to assist him in the preparation of cochineal, which is, I believe, found in *Bokhára*, as a worm attached to the root of a wild shrub. There was also an old man named HAJI MIRUK, who had seen the world from Canton to Constantinople, and secretly brought many old coins and rarities which are acceptable to Europeans. The most intimate perhaps of all our acquaintance was our landlord, an *Uzbek* merchant, named MAKHSUM, who traded to *Yárkand.* He paid us a daily visit, and generally brought some of his friends along with him. I shall mention an incident regarding this person, which is creditable to him. He was a most communicative man, and gave me much interesting information: as our intimacy increased, I interrogated him closely on the revenues and resources of *Bokhára,* on its extent and power, and produced a small map of the country to exhibit before him. He replied to all my inquiries, and then begging me to shut up the map, besought me never again to produce such a paper in *Bokhára,* since there were innumerable spies about the King, and it might be productive of very serious consequences. He still continued his visits, and his information with the same freedom as before. On our first arrival in the city, the keeper of the caravansary refused us quarters, because we had no character, that is, we were neither merchants nor ambassadors ; but this good man had let his house to us. He had been attacked by his neighbours, terrified by his friends, and he himself trembled at the risk which he had incurred. The keeper of the caravansary now hid his head in shame, and the landlord shared our intimacy ; his neighbours curried favor with him to be brought to us, and our society was more courted than was agreeable.

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## III.—*On the Climate of Nagpúr. By* W. Geddes, *Surgeon, Mad. Eur. Reg.*

To the Editor of the Journal of the Asiatic Society.

At the request of my friend, Mr. MALCOLMSON, of the left wing, Madras European Regiment, I have the pleasure to forward the result of some meteorological observations, which he tells me may be interesting to you. I am much afraid that he may have given you reason to expect more useful information on this subject than I have it in my power to give you; but the truth is, that I have generally confined my observations to the appearances on the sky, in the shape of clouds, and have paid less attention to the indications given by instruments; as I have been so situated that I have either not had sufficient leisure to make a regular series of observations on the latter, or those instruments in my possession have not been sufficiently correct to allow me to depend much upon them. This you will at once observe from the circumstance of my barometrical inquiries being made on the sympiesometer, in the accompanying table; and you will perceive that the instrument I have, which was received here apparently in good order, in the month of January, 1831, from England, has become liable to the objections made to it, by yourself, in the 15th volume of the Asiatic Researches*, and this to such a degree, that I am doubtful whether you can make any use of the results which I now send you. They fully bear out however your own observations. In Europe, it appears, the instrument is conceived to rise in its indications, instead of lowering, as with us, at least if I may judge from a note made in the 10th volume of Brewster's Journal of Science; although, by the bye, the remark is rather obscure. With respect to the hygrometer used by me, it is one upon Kater's plan of the *oubína* grass†, made by Robinson, in Devonshire Street, which is convenient from the facilities of ascertaining its indications. Its extreme dryness is 0, extreme moisture 9.05, and the state of the atmosphere is at once shown from the index on the top of the instrument. By some trials made with Daniell's hygrometer, 1.64 of Kater was equal to 31 degrees of dryness, and 1.96 of the former to 26 of dryness, and 3.69 to 10 degrees, as indicated by the dew-point on Daniell‡. You will perceive that I have not made my observations at the extremes of the diurnal changes in the atmosphere; but as I have already said, I have been in the habits chiefly of noting the state of my instrument more as explanatory of the appearances on the sky, than with other objects, and have accordingly chosen the periods which were most convenient to myself, for recording their indications. The state of the seasons, as extracted from my medical reports, will explain some points regarding the thermometer, and the quantity of rain given is that observed to have fallen at Nagpúr at the distance of nine miles of this place, and which was recorded by Dr. Wyllie, late Residency Surgeon there.

* Vide also Gleanings in Science, i. 201.

† *(Andropogon contortum.)*

‡ As the temperature, at which these comparisons were made, is not mentioned, it is impossible to form a correct scale for Kater's hygrometer: the safest plan will be to assume that equal increments denote nearly equal accessions of aqueous tension; 9.05 being 100 or extreme moisture, each indication may be divided by 9 to find the tension roughly.—Ed.

*Meteorological Observations made at Kamptí, near Nagpúr, from Feb. 1831, to March 1833, inclusive.*

| Month. | Sympiesometer. | | | | | | | | | Kater's Hygrometer. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 A. M. | | | 2 P. M. | | | 8 P. M. | | | 9 A. M. | | | 2 P. M. | | | 8 P. M. | | |
| | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. |
| Feb. 1831, | 29.24 | 28.91 | 29.02 | 29.13 | 28.72 | 28.87 | 29.12 | 28.75 | 28.92 | — | — | — | — | — | — | — | — | — |
| March, ... | —.12 | —.76 | 28.95 | —.04 | —.62 | —.79 | —.03 | —.65 | —.83 | 3.36 | 1.20 | 2.03 | 3.18 | 1.03 | 1.89 | 3.16 | 1.15 | 1.71 |
| April, .... | 28.92 | —.54 | —.74 | 28.80 | —.40 | —.60 | 28.82 | —.45 | —.63 | 2.63 | 0.53 | 1.77 | 2.30 | 0.48 | 1.54 | 2.47 | 0.45 | 1.48 |
| May, ..... | —.59 | —.32 | —.49 | —.46 | —.20 | —.36 | —.47 | —.22 | —.39 | 1.22 | 0.33 | 0.69 | 1.03 | 0.32 | 0.62 | 0.94 | 0.25 | 0.58 |
| June, ..... | —.60 | —.30 | —.45 | —.50 | —.13 | —.35 | —.53 | —.14 | —.37 | 4.57 | 0.52 | 2.72 | 5.21 | 0.48 | 2.69 | 4.98 | 0.47 | 2.58 |
| July, ..... | —.67 | —.43 | —.51 | —.55 | —.33 | —.41 | —.59 | —.33 | —.44 | 5.55 | 2.50 | 4.22 | 5.28 | 2.12 | 3.78 | 5.58 | 2.15 | 3.84 |
| August, ... | —.67 | —.43 | —.55 | —.56 | —.35 | —.46 | —.60 | —.37 | —.49 | 5.75 | 4.57 | 5.49 | 5.72 | 3.87 | 5.10 | 5.70 | 4.53 | 4.97 |
| September, | —.68 | —.45 | —.56 | —.55 | —.32 | —.44 | —.63 | —.40 | —.50 | 6.12 | 4.35 | 5.13 | 5.96 | 3.03 | 4.61 | 5.86 | 3.40 | 4.89 |
| October, .. | —.86 | —.55 | —.68 | —.70 | —.43 | —.53 | —.76 | —.50 | —.60 | 5.82 | 2.75 | 4.48 | 5.10 | 1.95 | 3.32 | 5.10 | 2.17 | 3.53 |
| November, | —.96 | —.70 | —.87 | —.82 | —.55 | —.73 | —.87 | —.61 | —.78 | 5.68 | 2.26 | 3.23 | 5.48 | 1.37 | 2.63 | 5.25 | 1.61 | 2.66 |
| December,. | 29.00 | —.83 | —.91 | —.89 | —.70 | —.80 | —.92 | —.74 | —.84 | 5.75 | 4.90 | 5.32 | 5.93 | 3.57 | 4.97 | 5.83 | 3.98 | 5.11 |
| Jan. 1832, . | —.05 | —.87 | —.98 | —.87 | —.70 | —.77 | —.93 | —.80 | —.84 | 5.03 | 2.50 | 3.49 | 3.75 | 1.35 | 2.51 | 3.82 | 1.45 | 2.99 |
| February, . | 28.94 | —.61 | —.78 | —.77 | —.42 | —.61 | —.84 | —.46 | —.69 | 5.58 | 1.99 | 3.09 | 5.67 | 1.20 | 2.45 | 5.27 | 1.27 | 2.61 |
| March, .... | —.81 | —.52 | —.64 | —.61 | —.30 | —.44 | —.68 | —.37 | —.50 | 3.56 | 1.16 | 1.73 | 3.88 | 0.91 | 1.22 | 3.16 | 1.03 | 1.31 |
| April, .... | —.54 | —.22 | —.36 | —.36 | —.05 | —.18 | —.42 | —.06 | —.24 | 1.62 | 0.53 | 0.97 | 1.23 | 0.33 | 0.66 | 1.35 | 0.32 | 0.71 |
| May, ..... | —.26 | —.06 | —.15 | —.12 | 27.93 | —.04 | —.13 | 27.98 | —.05 | 1.47 | 0.56 | 0.81 | *— | — | — | — | — | — |
| June, ..... | —.16 | 27.90 | —.02 | —.02 | —.80 | 27.89 | —.04 | —.80 | 27.92 | 5.85 | 0.77 | 2.31 | 5.70 | 0.73 | 1.80 | 5.62 | 0.63 | 2.25 |
| July, ..... | —.18 | —.92 | —.06 | —.10 | —.83 | —.97 | —.10 | —.87 | 28 00 | 5.45 | 3.64 | 4.63 | 5.48 | 3.08 | 4.18 | 5.34 | 3.20 | 4.30 |
| August, ... | —.28 | 28.10 | —.18 | —.20 | —.98 | 28.09 | —.22 | 28.04 | —.12 | 5.63 | 4.18 | 4.84 | 5.56 | 3.55 | 4.49 | 5 66 | 3.79 | 4.65 |
| September, | —.38 | —.15 | —.26 | —.13 | 28.00 | —.14 | —.30 | —.08 | —.20 | 5.78 | 3.08 | 3.99 | 5.81 | 1.66 | 2.74 | 5.72 | 2.26 | 3.45 |
| October... | —.51 | —.20 | —.38 | —.39 | —.06 | —.24 | —.43 | —.13 | —.28 | 3.50 | 1.56 | 2.55 | 2.65 | 0.85 | 1.73 | 3.07 | 0.96 | 1.89 |
| November. | —.64 | —.47 | —.55 | —.48 | —.33 | —.42 | —.55 | —.37 | —.47 | 2.32 | 1.90 | 2.11 | 1.82 | 1.27 | 1.24 | 1.89 | 1.48 | 1.67 |
| December, | —.66 | —.39 | —.52 | —.54 | —.26 | —.37 | —.60 | —.31 | —.44 | 3.70 | 1.31 | 2.10 | 3.08 | 1.14 | 1.74 | 2.98 | 1.14 | 1.75 |
| Jan. 1833,. | —.72 | —.40 | —.58 | —.55 | —.28 | —.43 | —.64 | —.32 | —.49 | 3.04 | 1.30 | 1.78 | 2.60 | 1.08 | 1.54 | 2.71 | 1.33 | 1.68 |
| February,, | —.52 | —.32 | —.43 | —.35 | —.16 | —.26 | —.42 | —.21 | —.31 | 2.40 | 0.75 | 1.37 | 1.99 | 0.62 | 1.06 | 1.87 | 0.72 | 1.07 |
| March,. .. | —.38 | —.18 | —.21 | —.20 | 28.00 | —.05 | —.24 | —.03 | —.14 | 1.25 | 0.45 | 0.71 | 0.87 | 0.35 | 0.54 | 0.86 | 0.36 | 0.51 |

| Month. | Fahr. Thermometer. | | | | | | | | | Rain. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sunrise in the open air. | | | 2 P. M. in the house. | | | 8 P. M. in the house. | | | |
| | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. | Highest. | Lowest. | Mean. | |
| Feb. 1831, | 68 | 54 | 62 | 85 | 70 | 76½ | 80 | 71 | 74½ | ,, ,, |
| March, ... | 83 | 55 | 69½ | 88 | 72 | 80½ | 88 | 72 | 80 | ,, ,, |
| April, .... | 86 | 69 | 78½ | 93½ | 83 | 88 | 93 | 80½ | 87 | ,, ,, |
| May, ..... | 93 | 80 | 88½ | 99 | 92 | 95½ | 98 | 93 | 95 | ,, ,, |
| June, ..... | 95 | 74½ | 81½ | 99 | 81 | 89½ | 99 | 82 | 89 | 13.78 |
| July, ..... | 83½ | 73 | 78 | 93 | 76½ | 86½ | 91 | 80 | 85 | 7.22 |
| August, ... | 78½ | 73 | 75½ | 86½ | 78½ | 82 | 83 | 79 | 81 | 14.58 |
| September, | 78 | 73 | 75½ | 85 | 79 | 82½ | 83 | 80 | 81½ | 11.98 |
| October, .. | 77 | 59 | 71 | 85 | 77 | 81½ | 84 | 76 | 81 | 7.24 |
| November, | 71 | 49 | 58½ | 81 | 71 | 74½ | 79 | 70 | 73 | 2.27 |
| December,. | 69 | 60 | 63 | 77 | 70 | 72½ | 74 | 70 | 72 | 8.24 |
| Jan. 1832, . | 62 | 47 | 52½ | 74 | 66½ | 69½ | 72 | 66 | 68½ | ,, ,, |
| February, . | 66½ | 52 | 59 | 80½ | 68½ | 74 | 77 | 69 | 71½ | 2.98 |
| March, .... | 70 | 53 | 62½ | 84 | 73 | 80 | 82 | 71 | 77 | —.43 |
| April, .... | 82 | 70 | 75 | 99 | 87 | 93 | 92 | 83 | 87½ | ,, ,, |
| May, ..... | 86½ | 71½ | 80 | 103 | 92 | 97 | 94 | 89 | 91½ | ,, ,, |
| June, ..... | 89½ | 75 | 81½ | 104½ | 82 | 94 | 93 | 82 | 88 | 8.01 |
| July, ..... | 79 | 73½ | 76⅓ | 87 | 79 | 84⅓ | 86 | 79 | 83½ | 14.49 |
| August, ... | 75 | 72 | 73½ | 83½ | 78 | 80 | 81½ | 78 | 79½ | 3.46 |
| September, | 75 | 68 | 72 | 86 | 75½ | 82 | 84 | 76½ | 81 | 7.77 |
| October... | 76 | 58½ | 67 | 85½ | 78 | 81½ | 84 | 77½ | 80½ | ,, ,, |
| November. | 63½ | 54 | 58½ | 80 | 73½ | 76½ | 78½ | 73 | 75½ | ,, ,, |
| December, | 62½ | 48 | 54½ | 77 | 67½ | 72½ | 74½ | 67½ | 71 | ,, ,, |
| Jan. 1833,. | 65 | 47 | 55 | 78 | 68½ | 73 | 75 | 68½ | 72 | ,, ,, |
| February,, | 68 | 50½ | 59 | 83½ | 72½ | 78 | 79 | 72 | 76 | ,, ,, |
| March,. .. | 76½ | 60 | 68 | 89 | 80 | 85 | 87 | 79 | 84 | ,, ,, |

* Vitiated by the influence of a wetted tatty.

*Extracts of Meteorological Remarks made in the Periodical Returns from the Medical Department of the Right Wing, Madras European Regiment, stationed at Kampti.*

First quarter of 1831.—" The period includes the last half of the cold and the commencement of the hot season. In January of the present quarter, the sky was for the most part clear throughout the month, the cloudy appearances never extending beyond a little cirrus, or cirro-cumulus, or a few cumuli dissolving in the evening; and the wind was most generally from some part of the west in the morning, and the east in the course of the day, but seldom blowing with great strength from any quarter, or continuing past sunset. The last day of January and first five days of February exhibited appearances of a more moist state of the atmosphere, with a greater variety in the cloudy formations, and there was a slight rain through the greater part of the second of this month, and again more heavily in the afternoon of the fourth. During the remainder of February, likewise, a greater degree of humidity prevailed, than in January, and nimbal masses were frequently to be seen around the horizon in the afternoon, or evening. The sky was generally covered with a layer, more or less dense or irregular, of a cirro-cumulous nature in the morning, and from this occasionally a few drops of rain were found to fall about sunrise, while cumuli succeeded to this in the course of the day. On the third the sky was obscured by a fog in the morning, and again on the 21st and 22nd a less degree of this description of cloud was present at the same time, in either case ending in cumuli. These cumuli, from whatever source originating, often changed into cirro-cumuli in the evening, and in other cases went on at an earlier part of the day, to form cumulo-strati, or nimbal clouds on various parts of the horizon. Excepting from the latter clouds, cirrus was but rarely seen, and there were only three perfectly clear days throughout the month. The wind, which was occasionally modified in the afternoon by the presence of clouds, observed the same general course as in January; but occasionally southerly wind began early in the forenoon, changing afterwards to one from the north-east, and this also was often found blowing more steadily than in the preceding month. The month of March presented occasional short periods of a moist description, having cumulo-stratus masses formed in the afternoon, and from one of these a considerable fall of rain took place on the night of the 10th. At other times, the appearances were much like those of the preceding months, but in a less degree, and the wind in general followed the same course as in February."

Second quarter of 1831.—" This period, as mentioned in former report, includes the height of the hot season, and the commencement of the rains. The seasons in general in this country, succeed to each other with so much regularity, and each in its appropriate period exhibits so little variety in the circumstances of different years, that it appears unnecessary to enlarge upon those of the present season, further than to point at same period of last year. Referring therefore to my report for this quarter of 1830, I have to state, that the chief peculiarities of the present season have been a greater, and more continued, degree of heat, than in the hot months of last year, a somewhat more early occurrence of the rains, and their being in greater abundance than during the month of June, in 1830. In the beginning of April, several showers fell, and one* of these, on the 8th of the month, consisted of hailstones, the largest of which varied from six to nine inches in circumference. From this period, however, on to the commencement of the monsoon, with the exception of a few drops at distant periods, no rain took place, and this space of two months was one unbroken continuation of hot-weather. During this time a registering thermometer, exposed to a breeze in an outer room, shewed the rising of the quicksilver daily from the 27th of April to the 7th of June, with three exceptions, to from 100 to 107. To this succeeded the rains, which commenced on the afternoon of the latter date, and throughout the remainder of the month showers took place almost daily; the quantity of rain by the end of the month being nearly double that of the same period of last year."

Third quarter of 1831.—"This period comprises the chief part of the rains, and at the same time the most unhealthy portion of the year. As mentioned in last report, a great quantity of rain fell in June; but this was followed by a dry period of twenty days, viz. from the 22nd of June, until the 11th of July. The remainder of the latter month was, generally speaking, wet, especially towards the end of the month; but altogether the rain which fell in July was somewhat below the quantity in the same period of last year. The month of August in both years has been attended with the most continued rain of the season, and this has kept up a continued degree of moisture on the surface throughout the month. In September, there have been a few larger intervals of fair weather, but occasionally heavy falls of rain have taken place, and the ground has been in a constantly moist state in consequence. The monsoon, on the whole, has been accompanied with the average quantity of rain, the chief peculiarities being the extensive fall in June, and the succeeding dry weather until the middle of July. The wind, as usual, has been chiefly from the westward, and, at times, in the early part of the season, has blown with considerable strength.

* Vide page 5.

In the month of August, however, and more especially in September, there have been occasionally north or south easterly winds, and some of these have been attended with heavy falls of rain."

Fourth quarter of 1831.—"The weather throughout the quarter has shewn little of that settled appearance which formed its principal feature in the same period of last year, and which is usual at this season. A greater tendency to the formation of cloudy masses upon the sky, and the frequent deposition of rain from these, has continued to prevail after the termination of the usual rainy months, than was manifested during the same period of 1830, and has given altogether to the present season the peculiarity of a combination of cold and moisture; but, at the same time, a less degree of extreme heat and cold, than are usual at *Kamptí* at this period of the year. The rain has fallen particularly from the 15th to the 20th of October, in the first and last week of November, and in the beginning, and from the 15th to the 26th of December. The winds have in the intervals of settled weather followed their usual course in these months, of blowing slightly from the eastward in the fore and afternoons, and occasionally in the evening; while, in the night and morning, there has either been a calm, or a slight wind from the westward. In the more unsettled portions of the quarter, the wind has either been irregular, or modified by the presence or passage of raining clouds, or it has shifted from either the north-east or south, to another quarter, from whence it has blown for a day or two, and the change has been generally attended by a greater or less degree of rains."

First half yearly return of 1832.—"The period, comprising the last half of the cold season, the whole of the hot-weather, and the commencement of the rains, has altogether been a favourable one with respect to the health of the regiment: and this circumstance appears to be referrible to the genial nature of the season, the temperature of which remained cool to a much later period than is usual; while along with this coolness, there has been more generally present a dry state of the atmosphere, than in the same seasons of the preceding years. The extreme heat, in the table prefixed, of Fahrenheit's thermometer appears greater, from the observations being taken in the two latter months, on a registering thermometer, and the records being made from the hottest period of the day. The general features of the weather have, as recorded in former reports, consisted, in the early part of the half year, of cool, generally cloudless, days, with little wind, diversified on the 20th of February by a considerable fall of rain, with wind from the eastward; and, latterly, until the 8th of June there has been a gradual or irregular increase of temperature, with occasional marks of greater moisture in the atmosphere; but excepting slightly on the 20th of March, no rain has fallen beyond a few drops till the period of June above-mentioned. The course of the season altogether has been observed to be more backward than is usual. The temperature has remained low to a later period; the progress of vegetation, as exhibited in the time of flowering of trees, and the maturation of their fruits, has been considerably behind what has been observed in previous years; and connected perhaps with the same cause, the rains have been beyond their more regular season of shewing themselves. Thus, after a little partial rain on the 8th of June, the hot winds recommenced, and there was no further fall of rain until the 17th of the month; since which period, till the date of this report, the season has resumed its usual course, and the weather has become moist and cool, with occasional falls of rain."

6th. Second half year of 1832.—"The period which includes the greater part of the rainy season, and half of the cold weather, has been distinguished by the abrupt cessation of the former, and the long continuance accordingly of a dry state of the atmosphere, with its necessary consequence of a less degree of moisture of the soil, and of vegetation; and, as will be supposed also, of sources of malaria. The regular rains may indeed be said to have terminated in the end of July in the present season; for in the month of August, in which usually the most continued or heavy falls take place, there has only been about a quarter of the usual supply, divided however very generally over the whole month; while in September, about half the quantity of the last two years has fallen, the greater part of which took place in the first four days of the month, and again on the 20th and 21st. Since this period, with the exception of a single shower on the 7th of October, and a slight rain on the 10th of December, the weather has been perfectly dry, exhibiting a settled appearance, with a cloudless sky; or it has been more or less disturbed by the presence of rain or storms in neighbouring latitudes, chiefly, it would appear, from other observations, to the eastward. Altogether, the quantity of rain of the present season does not exceed half of that of 1831, or two-thirds of 1830; and the fall is further peculiar in this, that unlike that of last year, which continued heavily on through the months of August, September, October, November, and December, and of 1830, which was also heavy in August and September, with a considerable fall likewise in October, the chief portion of the present year has taken place in the months of June and July, with only a scanty supply afterwards."

During the months of January, February, and March, 1833, the chief feature has been the continued dry state of the atmosphere; and, accordingly, the cloudy appearances, which have for a day or two, at times, shewn a less degree of this state, have never gone on to rain further than a few drops; while the weather has generally continued for long periods of an extremely settled appearance.

The hail-storm on the 8th of April, 1831, was referred at the time to the occurrence of an opposite current of dry winds, which appeared to impinge upon the sheet of rain presented to its influence, and the following description, taken from notes immediately afterwards, seems to confirm this idea. Neither the sympiesometer or thermometer shewed any thing worthy of notice at this period. The hygrometer had through the 6th and 7th of the month ranged from 1.40 to 1.72, and during the 8th, it stood at 2.17 at 9 A. M., 2.12 at 2 P. M., and 2.22 at 8 P. M. Until past 2 P. M. the appearances on the sky had been cirrus from a distant nimbal cloud in the morning, cirro-cumulus, loose cirro-stratus, and some cumuli, passing below this, also of a loose structure. The wind had been blowing from the eastward in the morning, changing in the forenoon to the south-east, and continuing from thence afterwards; but towards 2 P. M. the course of the cumuli above shewed a current of air flowing there from the westward. Shortly after two, some distant thunder was heard, and the sky had become nearly covered with cirrus. Cumuli were observed to commence raining in the west, and they increased in size, and approached from that direction about 4 P. M. Another nimbus was seen in the south-eastward, while that in the west was advancing, and loud gusts of wind with much dust began blowing from the former towards the latter. In the mean time, the western cloud kept approaching, the rain falling from it, presenting a whitish appearance above the dust, some scud was seen passing before it, in a course towards the east, and immediately a heavy fall of hail took place, driven by a wind from the westward. The hail continued to fall for several minutes, and the course of the cloud towards the east could be traced for at least four miles, by the damage done to the fruit trees, glazed windows, &c. in the cantonment. The breadth of the shower however was extremely small, the ground being found quite dry at a few hundred yards to the southward from where the hail, or rather the masses of ice, fell in greatest quantity. These masses were irregular, and clean on the outer surface; but in the centre presented a white crystallized appearance. Throughout the evening afterwards, several large cumulo-strati were seen in the east, with much lightning there; and a cool breeze blew from thence, with cumulous fragments of cloud on a clear sky.

W. G.

IV.—*Table shewing the Rise of Spring tides in Bombay Harbour, during night and day, for the year* 1832, *communicated by* Ben. Noton, *Esq.*

| Date and state of the Moon. | Rise of the Tide. | | | | Date and state of the Moon. | Rise of the Tide. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Day. | | Night. | | | Day. | | Night. | |
| | ft. | in. | ft. | in. | | ft. | in. | ft. | in. |
| January 14 | 0 | 0 | 14 | 6 | 11 | 0 | 0 | 14 | 6 |
| 15 | 13 | 6 | 16 | 0 | 12 | 13 | 9 | 15 | 6 |
| 16 | 14 | 3 | 16 | 5 | 13 | 14 | 6 | 15 | 9 |
| ○17 | 15 | 0 | 17 | 9 | 14 | 15 | 6 | 16 | 0 |
| 18 | 15 | 9 | 17 | 11 | ○15 | 15 | 9 | 16 | 0 |
| 19 | 16 | 0 | 17 | 11 | 16 | 16 | 0 | 15 | 5 |
| 20 | 16 | 0 | 17 | 6 | 17 | 15 | 8 | 14 | 6 |
| 21 | 15 | 6 | 0 | 0 | 18 | 15 | 2 | 0 | 0 |
| 28 | 0 | 0 | 12 | 6 | 26 | 0 | 0 | 12 | 9 |
| 29 | 11 | 3 | 13 | 6 | 27 | 12 | 9 | 13 | 9 |
| 30 | 12 | 0 | 14 | 3 | 28 | 13 | 6 | 14 | 3 |
| 31 | 12 | 6 | 15 | 0 | 29 | 14 | 6 | 14 | 9 |
| February 1 | 13 | 2 | 15 | 5 | ●30 | 15 | 6 | 15 | 0 |
| ●2 | 13 | 6 | 15 | 7 | May 1 | 16 | 3 | 15 | 5 |
| 3 | 14 | 0 | 15 | 7 | 2 | 16 | 7 | 15 | 3 |
| 4 | 14 | 2 | 0 | 0 | 3 | 16 | 9 | 0 | 0 |
| 12 | 0 | 0 | 13 | 6 | 10 | 0 | 0 | 13 | 3 |
| 13 | 12 | 6 | 14 | 8 | 11 | 13 | 3 | 14 | 0 |
| 14 | 13 | 6 | 15 | 9 | 12 | 14 | 3 | 14 | 3 |
| 15 | 14 | 6 | 16 | 9 | 13 | 14 | 9 | 14 | 3 |
| ○16 | 15 | 3 | 17 | 5 | ○14 | 15 | 0 | 14 | 3 |
| 17 | 16 | 9 | 17 | 5 | 15 | 15 | 0 | 13 | 9 |
| 18 | 15 | 9 | 17 | 0 | 16 | 14 | 9 | 13 | 3 |
| 19 | 15 | 3 | 0 | 0 | 17 | 14 | 3 | 0 | 0 |
| 27 | 0 | 0 | 11 | 6 | 26 | 0 | 0 | 13 | 0 |
| 28 | 11 | 0 | 12 | 9 | 27 | 13 | 6 | 13 | 6 |
| 29 | 11 | 6 | 14 | 0 | 28 | 14 | 6 | 14 | 3 |
| March 1 | 13 | 0 | 15 | 0 | 29 | 16 | 0 | 14 | 6 |
| ●2 | 14 | 0 | 15 | 9 | ●30 | 16 | 3 | 14 | 6 |
| 3 | 14 | 6 | 15 | 9 | 31 | 16 | 9 | 14 | 6 |
| 4 | 15 | 0 | 15 | 6 | June 1 | 16 | 9 | 14 | 3 |
| 5 | 14 | 9 | 0 | 0 | 2 | 16 | 6 | 0 | 0 |
| 12 | 0 | 0 | 13 | 6 | 9 | 0 | 0 | 13 | 0 |
| 13 | 12 | 6 | 15 | 0 | 10 | 14 | 0 | 13 | 6 |
| 14 | 14 | 0 | 16 | 3 | 11 | 14 | 9 | 14 | 0 |
| 15 | 14 | 9 | 16 | 9 | 12 | 15 | 3 | 14 | 3 |
| ○16 | 15 | 6 | 17 | 0 | ○13 | 15 | 6 | 14 | 6 |
| 17 | 15 | 9 | 17 | 0 | 14 | 15 | 9 | 14 | 9 |
| 18 | 16 | 0 | 16 | 6 | 15 | 15 | 11 | 14 | 9 |
| 19 | 16 | 0 | 0 | 0 | 16 | 15 | 9 | 0 | 0 |
| 27 | 0 | 0 | 12 | 3 | 24 | 0 | 0 | 13 | 0 |
| 28 | 11 | 6 | 13 | 6 | 25 | 14 | 0 | 14 | 0 |
| 29 | 12 | 9 | 14 | 9 | 26 | 15 | 6 | 14 | 6 |
| 30 | 13 | 9 | 15 | 0 | 27 | 16 | 6 | 14 | 9 |
| 31 | 14 | 6 | 15 | 3 | ●28 | 17 | 0 | 15 | 0 |
| April ●1 | 15 | 3 | 15 | 9 | 29 | 17 | 6 | 15 | 3 |
| 2 | 15 | 9 | 16 | 0 | 30 | 17 | 9 | 14 | 9 |
| 3 | 16 | 0 | 0 | 0 | July 1 | 17 | 3 | 0 | 0 |

| Date and state of the Moon. | Rise of the Tide. Day. ft. | in. | Night. ft. | in. | Date and state of the Moon. | Rise of the Tide. Day. ft. | in. | Night. ft. | in. |
|---|---|---|---|---|---|---|---|---|---|
| July 8 | 0 | 0 | 12 | 0 | October 5 | 0 | 0 | 11 | 6 |
| 9 | 13 | 0 | 12 | 6 | 6 | 12 | 9 | 12 | 6 |
| 10 | 13 | 9 | 12 | 9 | 7 | 13 | 9 | 13 | 6 |
| 11 | 14 | 3 | 13 | 0 | 8 | 14 | 0 | 14 | 3 |
| 12 | 14 | 7 | 13 | 0 | 9 | 14 | 5 | 15 | 0 |
| ○13 | 14 | 7 | 13 | 0 | ○10 | 15 | 0 | 15 | 3 |
| 14 | 14 | 11 | 13 | 0 | 11 | 15 | 0 | 15 | 6 |
| 15 | 14 | 11 | 0 | 0 | 12 | 14 | 9 | 0 | 0 |
| 23 | 0 | 0 | 12 | 0 | 20 | 0 | 0 | 13 | 9 |
| 24 | 14 | 0 | 13 | 0 | 21 | 14 | 9 | 14 | 9 |
| 25 | 15 | 3 | 14 | 0 | 22 | 15 | 3 | 15 | 6 |
| 26 | 16 | 3 | 15 | 0 | 23 | 15 | 6 | 16 | 3 |
| ●27 | 17 | 3 | 15 | 6 | ●24 | 15 | 6 | 16 | 3 |
| 28 | 17 | 6 | 16 | 0 | 25 | 15 | 3 | 16 | 0 |
| 29 | 17 | 9 | 16 | 3 | 26 | 14 | 9 | 15 | 6 |
| 30 | 17 | 3 | 0 | 0 | 27 | 13 | 5 | 0 | 0 |
| August 7 | 0 | 0 | 11 | 9 | November 4 | 0 | 0 | 12 | 6 |
| 8 | 13 | 3 | 12 | 3 | 5 | 13 | 3 | 13 | 16 |
| 9 | 14 | 3 | 12 | 8 | 6 | 13 | 9 | 14 | 6 |
| 10 | 14 | 6 | 13 | 3 | 7 | 14 | 3 | 15 | 9 |
| ○11 | 14 | 9 | 13 | 6 | ○ 8 | 14 | 9 | 16 | 3 |
| 12 | 15 | 0 | 13 | 10 | 9 | 14 | 11 | 16 | 6 |
| 13 | 15 | 1 | 13 | 10 | 10 | 14 | 7 | 16 | 3 |
| 14 | 15 | 1 | 0 | 0 | 11 | 14 | 0 | 0 | 0 |
| 22 | 0 | 0 | 12 | 3 | 18 | 0 | 0 | 14 | 0 |
| 23 | 14 | 3 | 13 | 3 | 19 | 14 | 0 | 14 | 9 |
| 24 | 15 | 6 | 14 | 6 | 20 | 14 | 6 | 15 | 6 |
| 25 | 16 | 6 | 15 | 0 | 21 | 14 | 9 | 16 | 3 |
| ●26 | 16 | 9 | 15 | 9 | ●22 | 14 | 9 | 16 | 3 |
| 27 | 16 | 9 | 16 | 0 | 23 | 14 | 3 | 16 | 3 |
| 28 | 16 | 9 | 15 | 9 | 24 | 14 | 0 | 15 | 9 |
| 29 | 16 | 3 | 0 | 0 | 25 | 13 | 6 | 0 | 0 |
| September 5 | 0 | 0 | 11 | 6 | December 3 | 0 | 0 | 13 | 0 |
| 6 | 12 | 9 | 11 | 9 | 4 | 13 | 0 | 14 | 0 |
| 7 | 13 | 6 | 12 | 6 | 5 | 13 | 6 | 15 | 0 |
| 8 | 14 | 3 | 13 | 3 | 6 | 14 | 3 | 16 | 6 |
| 9 | 14 | 9 | 14 | 0 | 7 | 14 | 9 | 17 | 0 |
| 10 | 15 | 0 | 14 | 3 | ○ 8 | 15 | 0 | 17 | 8 |
| ○11 | 15 | 3 | 14 | 6 | 9 | 15 | 0 | 17 | 8 |
| 12 | 15 | 3 | 0 | 0 | 10 | 15 | 0 | 0 | 0 |
| 20 | 0 | 0 | 12 | 0 | 18 | 0 | 0 | 14 | 0 |
| 21 | 14 | 3 | 13 | 0 | 19 | 13 | 3 | 14 | 9 |
| 22 | 15 | 0 | 14 | 3 | 20 | 13 | 3 | 15 | 3 |
| 23 | 16 | 0 | 15 | 3 | 21 | 13 | 3 | 15 | 9 |
| ●24 | 16 | 3 | 15 | 10 | ●22 | 13 | 6 | 16 | 0 |
| 25 | 16 | 3 | 16 | 0 | 23 | 13 | 6 | 16 | 0 |
| 26 | 16 | 0 | 15 | 6 | 24 | 13 | 0 | 15 | 3 |
| 27 | 14 | 9 | 0 | 0 | 25 | 13 | 0 | 0 | 0 |

## V.—*On the Native Manufacture of Turpentine.*

It would be an useful point of inquiry to discover in how far we may turn the natural as well as artificial products of this country to account, without looking elsewhere, and particularly to England: in the shape of magazine stores, Government has from the beginning been importing articles of various descriptions at a great expence, and at great risk; many of which are not only procurable in the country, but to be purchased at a rate much lower, and of a quality infinitely superior, to those from England. No person acquainted with the interior of an arsenal or magazine, who has given the matter any consideration whatever, can be at a loss to see how the question applies, and both as a matter of economy, and as a method of introducing stores of a better description into the public depôts, a professional officer could not better apply his attention, than in endeavoring to prove to Government the value of such an inquiry. I will, as opportunity offers, bring forward points that come under my immediate observation; and although to many people the subjects of discussion may appear trifling and uninteresting, or unworthy of that consideration, that I am inclined to give them, it must still be recollected, that a very trifling saving on the *rate* of an article much in requisition is a matter of considerable importance, where the consumption of the article in question is great.

In commencement of the subject, I will take the common fir (Pinus longifolia), native name *chír,* in great abundance in the lower line of hills that skirts the *Dúns,* or valleys (at the foot of the Himálayas), and separating them from the plains. From this tree the natives obtain, in their rough way, tar and turpentine, and use the wood for work where lightness is required. The tar made by them, I imagine, is equal to that obtained by a more refined process, and the turpentine merely requires that attention which every establishment under the eye of skilful management could give, in producing the article as good as that from Europe. The method of obtaining tar, as put into practice by the natives at the foot of these hills, is more simple, and apparently better than what is described as the custom in Norway, and other countries in Europe, where tar is made by the foresters. The wood selected for the purpose is that which has either been cut or blown down the previous season, and which is dry. This is cut up into small pieces, and put into large earthen pots, holding about 10 seers (or *gurtass),* with narrow necks, through the bottom of which holes of about $\frac{1}{5}$ of an inch have been drilled. A pot so filled with the wood is then luted over with wet mud on the top and sides, and a hole being dug in the ground, a smaller pot, holding about $\frac{3}{4}$ of a seer of the same description as the above, is placed in it, over which the large one is put, and the space round refilled with earth; a heap of cow-dung, about 15 seers, is then piled over the whole, (which during the operation requires replenishing with about an equal quantity;) this is set fire to, and kept burning for about eight or nine hours, after which, the pots are removed, and the tar which has run off into the lower vessel, is put aside into a receptacle for that purpose: each pot runs off about five chittaks of tar, and gives a refuse of about a seer of charcoal—five men will make about two maunds and 10 seers, or nine of these pots full of tar, during the month, and the expence of the article will be as follows:

| | | | |
|---|---|---|---|
| 1. One head man, at per month,.................. | 5 | 0 | 0 |
| Four men, at each four rupees,................. | 16 | 0 | 0 |
| Purchase of pots and sundries,................ | 1 | 0 | 0 |
| Total,.................. | 22 | 0 | 0 |

Which on $2\frac{1}{4}$ maunds will give a rate per seer of three annas and 11 pie, nearly, from which is to be deducted the value of the charcoal, which in a large manufactory is considerable; in the above seven maunds, 35 seers, which in the forests would sell for two rupees, reducing the rate per seer of tar to three annas seven pie nearly. This tar is used on the boats on the Doab Canal, and also on the wood-work of the dams and regulating bridges, and wherever a weather boarding mixture is required; and I believe it may be recommended in every way. The common native turpentine is used also with the tar for these purposes. The fir-wood itself is good for boxes, table, planks, and articles of that description, and also makes floats for rafting the heavier varieties of wood: it has also been used in making boats, (an experiment tried from its lightness, and cheapness of working,) but without that success that was anticipated, the planking having become completely rotten and unserviceable after the work of two seasons. The natives hold the wood in no esteem whatever, but experience has shewn that for the purposes above-mentioned, namely for boxes, &c. this fir is as good as the common deal, and from its excessive lightness is certainly to be highly prized.

Fig. 1. of Plate IX. exhibits a sectional view of the simple turpentine-still of the natives; *a* is the vessel in which the wood is heated; *b* that in which the turpentine is collected.

B.

*Northern Doab, March 26th,* 1833.

## VI.—*Description of a Sun Dial in the Court of the Motí Masjíd, in the Fort of Agra.* By *Capt.* J. T. Boileau, *Engineers.*

Among the curiosities of this once great emporium of learning and art, which have attracted the attention of strangers, is a dial-plate of white marble, with lines inlaid on its surface of a black slate; similar to the accompanying sketch. The style, which appears to have been an upright round pin, is gone, and the inlaying has been pulled out; but the configuration of the lines is still perfect, being marked by the channels wherein the inlaying fitted. The breadth of these channels is about $\frac{3}{8}$th of an inch.

The dial-plate is set up in the court of the *Motí Masjíd,* a building which was constructed in the latter end of the reign of Aurangzib, about the year 1673, and it is probable that this dial was put up about the same time; but whether in its present site and position, or elsewhere, I have not been able to ascertain.

The absence of hour lines, excepting XII and VI A. M. and P. M. would lead to the supposition, that the object for which the dial was constructed had reference only to the times of Mussulman prayer; but the object of the circular arc, which subtends an angle of about 95 degrees, has never been explained, although many celebrated *Moulavís* have visited the *Masjíd* and examined the dial as it stands.

The surface of the dial inclines south about $\frac{3}{8}$ths of an inch, which leads me to believe, that it has been removed from the place where it was originally fixed; for the inclination is too small to affect the projection of the shadow of the gnomon in any sensible degree, and I believe, therefore, that it stood originally in a perfectly horizontal position.

With regard to the true north point of the dial, it is difficult from the mere inspection of the lines upon it to come to any determination. The *Motí Masjíd* stands in lat. 27° 9′ nearly, and the sun's greatest declination N. being 23° 27$\frac{1}{2}$′, he of course can never approach nearer our zenith than 3° 41′ to the south. It is not possible, therefore, that the circular arc, which is inclined about 29° to the present meridian line, could under any circumstances mark the path of the shadow of a style placed as the style of this dial was, in a vertical position.

*Agra, March* 21*st,* 1833.

## VII.—*Catalogue of the most remarkable Celestial Objects visible in the horizon of Calcutta, arranged in order of Right Ascension.*

We have obtained permission to give publicity to the following catalogue, which was drawn up by Sir J. S. W. Herschell, to accompany the ten feet reflecting telescope sent out to India by that distinguished astronomer for the private use of his relations in this country. It will of course answer equally well for other telescopes, and will in some measure serve as a test of their goodness and space-penetrating power.

The names and numbers in the last two columns refer to Bode's maps of the constellations, which afford a ready means of finding the place of the object in the heavens, as they represent the stars of the celestial sphere *direct*, whereas upon the globe they are necessarily reversed. But to those who do not possess Bode's maps, the right ascension and declination will, with a little more trouble, enable the common observer to discover their position, while the astronomer with his transit will find out the whole with ease*.

*Explanation of the signs used in the Catalogue.*

*Column* 1, contains an enumeration of the whole. One asterisk (*) placed against a number denotes that the object is striking; two asterisks (**) that it is particularly curious.

*Column* 2, contains the right ascension in hours, minutes, and seconds.

*Column* 3,——— the declination in degrees and minutes.

*Column* 4, N and S, indicate whether the declination is north or south.

*Column* 5, gives the authority whence the objects are extracted. The Roman numbers 'I. II. III.' &c. refer to Sir W. Herschell's catalogue of nebulæ and double stars by classes.

△ refers to Dunlop's catalogue of southern nebulæ.

△′ ditto to ditto, double stars.

M ditto to Messier's nebulæ.

*Column* 6, describes the object by the following signs.

N, nebula.

D, double.

⊕, globular cluster.

○, planetary nebulæ.

❀, cluster of irregular figure.

⊙, nebulous star.

*Column* 9, refers to the numbered maps of "*Bode's Constellations.*"

* Our readers will remember the announcement at Bombay, in October last, of the discovery of Biela's Comet, which from its being so stationary was supposed to be coming direct towards the earth: the situation of the object proved it to be the nebula in Andromeda, No. 3. When really seen by Sir John Herschell on the 23rd September and again in November, the comet did however really appear exactly similar to a faint circular nebula.

| | R. Ascension. | Declination. | N. or S. | Authority. | Obj. | Description of Object. | Constellation. | No. of Map. |
|---|---|---|---|---|---|---|---|---|
| | h. m. s. | ° ′ | | | | | | |
| 1 | 0 6 50 | 40 10 | S. | Δ 507 | N. | " A beautiful long nebula." | Apparatus Sculptoris. | 17 |
| 2 | 0 23 16 | 63 56 | S. | Δ′ 1 | D. | β Toucani. iv. class. 4th=4th mag. a superb D. Star—but barely rises above the Calcutta horizon. | Toucan. | 20 |
| **3 | 0 33 26 | 40 21 | N. | | N. | The great nebula in Andromeda. | Andromeda. | 4 |
| 4 | 0 38 51 | 56 55 | N. | | D. | η Cassiopeiæ. A *Binary* star, of finely contrasted colours. | Cassiopeiæ. | 4 |
| *5 | 0 39 13 | 26 16 | S. | V. 1 | N. | A very large long neb. | Cetus. | 17 |
| 6 | | | | | | | | |
| 7 | 1 4 6 | 6 39 | N. | | D. | ζ Piscium. | Pisces. | 11 |
| 8 | 1 19 43 | 33 31 | S. | Δ′ 3 | | " A star 7m of a very uncommon red-purple colour. Very dusky, &c." | Machina electrica. | 17 |
| 9 | 1 24 15 | 29 52 | N. | M. 33 | ✿ | A fine large cluster, 18′ diameter. | Pisces. | 11 |
| 10 | 1 44 13 | 18 27 | N. | | D. | γ Arietis, 2nd or 3rd class. | Aries. | 11 |
| 11 | 1 47 20 | 36 55 | N. | VII. 32 | ✿ | A large and very rich cluster. | Andromeda. | 4 |
| *12 | 1 53 16 | 1 56 | N. | | D. | α Piscium. II Class. | Pisces. | 11 |
| 13 | 1 53 29 | 41 31 | N. | | D. | γ Andromedæ. A superb double star of strongly contrasted colours. | Andromeda. | 4 |
| 14 | 2 6 53 | 56 22 | N. | VI. 33 | ✿ | A pair of fine rich clusters, almost joining.—In the sword-handle of Perseus. | Perseus. | 4 |
| 15 | 2 9 46 | 56 21 | N. | VI. 34 | ✿ | | | |
| *16 | 2 31 0 | 41 59 | N. | M. 34 | ✿ | The Brilliant cluster in Perseus. | Perseus. | 4 |
| 17 | 2 34 12 | 0 44 | S. | M. 77 | N. | Very bright nebula. | Cetus. | 17 |
| 18 | 2 51 19 | 41 0 | S. | Δ′ 9 | D. | θ Eridani. Magn. 4 and 6 ; dist. 10″. | Eridanus. | 20 |
| 19 | 3 7 47 | 55 55 | S. | Δ 337 | ⊕ | A small bright globular cluster. | Horologium. | 20 |
| 20 | | | | | | | | |
| 21 | 3 51 40 | 60 25 | N. | IV. 53 | ○ | A pretty bright planetary nebula. 1′ diam. invis. to naked eye. | Camelopardalis. | 5 |
| 22 | 3 58 28 | 30 20 | N. | IV. 69 | ⊙ | A star 8m with a nebulous atmosphere. A most curious object, but probably difficult to find, being invisible to the naked eye. | Perseus. | 4 |
| 23 | 4 6 38 | 13 11 | S. | IV. 26 | ○ | A very bright planetary nebula. | Eridanus | 17 |
| 24 | 4 43 52 | 28 14 | N. | | | A ruby-coloured star 8m. | Taurus. | 12 |
| 25 | 5 6 22 | 8 24 | S. | | D. | Rigel. The companion is very small, and only 9″ distant from the large star. | Orion. | 12 |
| *26 | 5 7 0 | 40 15 | S. | Δ 508 | ⊕ | Described by Dunlop, as the brightest small nebula he has seen, diam. 1′½. | Cœla. | 18 |
| 27 | 5 14 34 | 35 38 | N. | M. 38 | ✿ | The cluster in Auriga. | Auriga. | 5 |
| *28 | 5 24 8 | 21 49 | N. | M. 1 | N. | An irresolvable nebula (near | Taurus. | 12 |

| | R. Ascension. | Declination. | N. or S. | Authority. | Obj. | Description of Object. | Constellation. | No. of M. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | ζ Tauri). A very curious object. | | |
| *29 | 5 24 40 | 34 11 | N. | M. 36 | | Large brilliant cluster in Auriga. | Auriga. | 5 |
| 30 | 5 25 36 | 9 49 | N. | | D. | λ Orionis. | Orion. | 12 |
| *31 | 5 27 13 | 5 31 | S. | | ⊙ | The great nebula about θ Orionis. The most extraordinary object perhaps in the heavens. | Orion. | 12 |
| 32 | 5 32 6 | 2 4 | S. | | D. | ζ Orionis. Very close. Difficult. | Orion. | 12 |
| 33 | 5 32 37 | 9 0 | N. | IV. 34 | ○ | Planetary nebula. | Orion. | 12 |
| 34 | 5 58 26 | 24 3 | N. | M. 35 | | A fine large brilliant cluster. | Gemini. | 12 |
| 35 | 6 14 30 | 4 41 | N. | | D. | 8 Monocerotis, 3rd class. | Monoceros. | 18 |
| 36 | 6 48 0 | 13 50 | S. | | D. | μ Canis Majoris, 1st class. | Canis Maj. | 18 |
| 37 | 6 54 55 | 8 9 | S. | M. 50 | | Beautiful cluster of large stars. | Monoceros. | 18 |
| 38 | 7 9 36 | 22 17 | N. | | D. | δ Geminorum, 3rd class. | Gemini. | 12 |
| *39 | 7 23 44 | 32 15 | N. | | D. | Castor, 3rd class. Superb *Binary* star. Period of revolution 262 years. | Gemini. | 12 |
| 40 | 7 31 48 | 26 26 | S. | Δ′ 53 | D. | κ Argûs. Superb D. star 3rd class. | Argo. | 18 |
| 41 | 7 34 16 | 14 25 | S. | M. 46 | | A very singular object. A cluster of stars which has within it a planetary nebula, *if* the 10 feet will shew it, which is doubtful. | Officina Typographica. | 18 |
| *42 | 7 34 38 | 17 50 | S. | IV. 64 | ○ | A beautiful planetary nebula, 12 or 15′ in diam. | Argo. | 18 |
| *43 | 8 2 27 | 18 10 | N. | | D. | ζ Cancri. Triple 1st and 3rd classes. The close small star revolves about the larger in 55 years. | Cancer. | 13 |
| 44 | 8 16 18 | 27 30 | N. | | D. | φ 2 Cancri, 2nd class. | Cancer. | 13 |
| 45 | 8 36 23 | 29 23 | N. | | D. | ι Cancri. 4th class. Strongly contrasted colours. Large star yellow, small deep blue. | Cancer. | 13 |
| 46 | 8 42 8 | 12 30 | N. | M. 67 | | An immensely rich cluster. | Cancer. | 13 |
| 47 | 9 40 50 | 69 55 | N. | ,, 81,82 | N. | A nebula 15′ long in Ursa. | Ursa. | 6 |
| *48 | 10 10 35 | 20 42 | N. | | D. | γ Leonis. A most beautiful close double star. Rather difficult. *Binary*. Period of revolution probably about 700 years. | Leo. | 13 |
| *49 | 10 16 49 | 17 48 | S. | IV. 27 | ○ | A beautiful planetary nebula, 40″ or 1′ diameter, like Jupiter. | Hydra. | 19 |
| *50 | 11 8 48 | 32 30 | N. | | D. | ζ Ursæ Majoris 1st class. *Binary*. Period well ascertained 58¾ years. One of the most remarkable D. stars. Rather difficult, being only 2″ apart. | Ursa. | 6 |

| | R. Ascension. | Declination. | N. or S. | Authority. | Obj. | Description of Object. | Constellation. | No. of M. |
|---|---|---|---|---|---|---|---|---|
| | *h. m. s.* | | | | | | | |
| 51 | 11 11 30 | 13 56 | N. | M. 66 | N. | A very bright lengthened nebula. | Leo. | 13 |
| *52 | 12 16 50 | 62 7 | S. | Δ′ 123 | D. | α Crucis, 2nd class. The brightest and most remarkable double star in the southern hemisphere†. Barely rises above the Calcutta horizon, high enough to be tolerably well seen. † α Centauri excepted. | Crux. | 20 |
| 53 | 12 27 52 | 26 55 | N. | V. 24 | N. | A long sword-shaped nebula. | Coma Beren. | 7 |
| *54 | 12 33 3 | 0 31 | S. | | D. | γ Virginis. One of the most remarkable of the *Binary* stars. Period of revolution 513 years. Close and difficult, and becoming more so. | Virgo. | 14 |
| *55 | 12 33 56 | 33 29 | N. | V. 42 | N. | A very long narrow nebulous ray. | Canes Venatici. | 7 |
| 56 | 12 47 9 | 39 16 | N. | | D. | α Canum. Cor. Caroli, 4th class. Contrasted colours. | Canes Ven. | 7 |
| 57 | 12 48 32 | 22 36 | N. | M. 64 | N. | A nebula with a nucleus and a black recess. | Coma Ber. | 7 |
| 58 | 13 4 47 | 19 7 | N. | M. 53 | ⊕ | A condensed globe of stars. | Coma Ber. | 7, 14 |
| 59 | 13 7 4 | 42 58 | N. | M. 63 | ⊛ | A very bright extended mass of stars like the finest dust. | Canes Ven. | 7 |
| 60 | 13 15 3 | 28 58 | S. | Δ 628 | ⊕ | A globular cluster suddenly condensed toward the centre to an extraordinary degree. | Centaurus. | 19 |
| **61 | 13 16 0 | 46 34 | S. | Δ 440 | ⊕ | ω Centauri—not a star, but a very large and splendid globular cluster—the finest in the southern hemisphere. | Centaurus. | 19 |
| **62 | 13 22 40 | 48 3 | N. | M. 51 | ⊚ | A most wonderful object. A globe surrounded by a double ring of nebula.—It has a neb. near it, as a companion. It is *unique* in the heavens. | Canes Ven. | 7 |
| 63 | 13 34 49 | 29 13 | N. | M. 3 | ⊕ | A much compressed cluster. | Canes Ven. | 7 |
| 64 | 13 58 11 | 55 13 | N. | M. 101 | N. | A very bright nebula. | Ursa Maj. | 6 |
| 65 | 14 10 27 | 57 40 | S. | Δ′ 159 | D. | γ Centauri, 3rd class, 5 and 8 m. | Centaurus. | 20 |
| *66 | 14 28 0 | 60 6 | S. | Δ′ 165 | D. | α Centauri, 4th class, 1st and 4th magnitudes. Distance 19.″ The brightest double star in the S. hemisphere. Very low in the S. horizon, but may be occasionally pretty well seen. | Centaurus. | 20 |

| | R. Ascension. | Declination. | N. or S. | Authority. | Obj. | Description of Object. | Constellation. | No. of M. |
|---|---|---|---|---|---|---|---|---|
| | *h. m. s.* | | | | | | | |
| 67 | 14 37 34 | 27 48 | N. | | D. | ε Bootis. A delicate but beautiful object. Small star. Blue. 1st class. | Bootis. | 7 |
| 68 | 14 51 8 | 32 21 | S. | △ 611 | ⊛ | A star 7 8 m. with a nebulous burr round it. | Lupus. | 15 |
| 69 | 15 10 6 | 2 42 | N. | M. 5 | ⊕ | Very compressed globular cluster, diameter 7 or 8′. A fine object. | Libra. | 14 |
| 70 | 15 32 8 | 37 11 | N. | | D. | ξ Coronæ. | Corona. | 7 |
| 71 | 15 46 1 | 33 30 | S. | △′ 196 | D. | ζ Lupi. An elegant D. star. | Lupus. | 15 |
| 72 | 15 55 0 | 19 18 | S. | | D. | β Scorpionis. | Scorpio. | 15 |
| 73 | 16 6 49 | 22 31 | S. | M. 80 | ⊕ | A very compressed beautiful globular cluster. | Scorpio. | 15 |
| **74 | 16 36 22 | 36 47 | N. | M. 13 | ❁ | One of the finest and most condensed of all the globular clusters between η and ζ Herculis. | Herculis. | 8 |
| *75 | 16 37 18 | 24 7 | N. | Struve. | ○ | Very bright planetary disc, 6″ in diameter. | Hercules. | 8 |
| *76 | 16 43 6 | 47 55 | N. | IV. 50 | ○ | Very bright planetary nebula 4′ diameter. | Hercules. | 8 |
| 77 | 16 48 22 | 3 49 | S. | M. 10 | ⊕ | Beautiful cluster of very small stars. | Ophiuchus. | 9 |
| 78 | 16 52 10 | 26 0 | S. | M. 19 | ⊕ | A compressed cluster, 4′ or 5′ diameter. | Scorpio or Ophiuchus. | 15 9 |
| 79 | 17 6 54 | 14 35 | N. | | D. | α Herculis. Contrasted colours. | Herculis. | 8 |
| 80 | 17 9 6 | 18 18 | S. | M. 9 | ⊕ | Very large bright ⊕ of extremely small stars. | Ophiuchus | 9 15 |
| *81 | 17 13 1 | 43 18 | N. | M. 92 | ⊕ | A globe of stars crowded together beyond imagination. | Herculis. | 8 |
| 82 | 17 19 1 | 23 37 | S. | IV. 11 | ○ | Pretty bright, 30″ diameter. A well defined planetary disc. | Ophiuchus. | 9 15 |
| 83 | 17 23 40 | 44 38 | S. | △ 457 | ⊛ | A nucleus, 15″ surrounded by a nebulous atmosphere, 5′ diameter. | Norma et Regula. | 15 |
| *84 | 17 52 1 | 23 2 | S. | | D.N | A 1st class *double star* in the centre of a *triple nebula*. N. B. The star is *triple*. | Sagittarius. | 15 |
| 85 | 17 53 47 | 22 28 | S. | M. 21 | ❁ | A rich cluster of large stars. | Sagittarius. | 15 |
| 86 | 17 55 14 | 43 38 | S. | △ 473 | ⊕ | Globular cluster, 3′ diameter. Excessively compressed at the centre. | Telescopium. | 0 |
| *87 | 17 56 6 | 2 33 | N. | | D. | 70 Ophiuchi. *Binary*; period of revolution about 80 years. One of the most remarkable of the well ascertained *Binary systems*. | Ophiuchus. | 9 |
| 88 | 18 0 | 66 38 | N. | IV. 37 | ⊙ | 35′ diameter. Edges hazy. | Draco. | 3 |

| | R. Ascension. | Declination. | N. or S. | Authority. | Object. | Description of Object. | Constellation. | No. of Map. |
|---|---|---|---|---|---|---|---|---|
| | h. m. s. | | | | | | | |
| *89 | 18 3 48 | 6 50 | N. | Struve. | ○ | A very bright planetary disc, 5″ diameter. | Scutum Sobieski. | 9 |
| 90 | 18 10 45 | 16 15 | S. | M. 17 | N. | The 10-feet will probably only shew this as an oval nebula, but its true shape is  and it is one of the most curious objects in the heavens. | Scutum Sobieski. | 15, 9 |
| 91 | 18 19 37 | 32 31 | S. | M. 69 | ⊕ | Very bright and pretty large. | Sagittarius. | 15 |
| 92 | 18 25 41 | 24 3 | S. | M. 22 | ⊕ | Very large globular cluster, 8′ diameter. | Sagittarius. | 15 |
| *93 | 18 38 6 | 39 30 | N. | ⊡ | D. | ε Lyræ. A double — double star, each pair, being a *Binary*, and probably the whole a compound quarternary system: a very pretty object, and very easily found. | Lyra. | 8 |
| 94 | 18 41 59 | 6 28 | S. | M. 11 | ⊕ | The cluster in Antinous. | Antinous. | 9 |
| *95 | 18 48 10 | 32 50 | N. | M. 57 | ◎ | An elliptic ring—a most singular object. Is easily found, as it lies hardly half way between β and γ Lyræ, and is visible in the finder (but *barely*). | Lyra. | 8 |
| *96 | 19 23 52 | 27 37 | N. | | D. | β Cygni. A beautiful coarse D star of finely contrasted colours. | Cygnus. | 8 |
| 97 | 19 28 55 | 31 20 | S. | M. 55 | ⊕ | Very large rich cluster, 9′ diameter. | Sagittarius. | 15 |
| *98 | 19 34 6 | 14 33 | S. | IV. 51 | ○ | 10″ or 15″ diameter. Considerably bright. | Sagittarius. | 15 |
| **99 | 19 52 48 | 22 20 | N. | M. 27 | N. | A most extraordinary object. A nebulous mass, shaped like a dumb bell, and involved in an elliptic faint atmosphere. N.B. The 10-feet reflector will not shew the atmosphere, but the body will be well seen. | Vulpecula. | 8 |
| 100 | 19 58 56 | 22 24 | S. | M. 75 | ⊕ | Very bright, large, round. | Sagittarius. | 15, 16 |
| 101 | 20 15 5 | 19 33 | N. | IV. 16 | ○ | 45″ diameter. Round, pretty bright. | Do. | 8 |
| 102 | 20 25 17 | 7 10 | N. | I. 103 | N. | Very beautiful, large, easily resolveable. | Delphinus. | 10 |
| 103 | 20 38 8 | 15 29 | N. | | D. | γ Delphini. | Delphinus. | 10 |
| 104 | 20 54 56 | 12 1 | S. | IV. 1 | ○ | One of the largest and finest of the planetary nebulæ, near ν Aquarii, by which it is easily found. | Aquarius. | 16 |

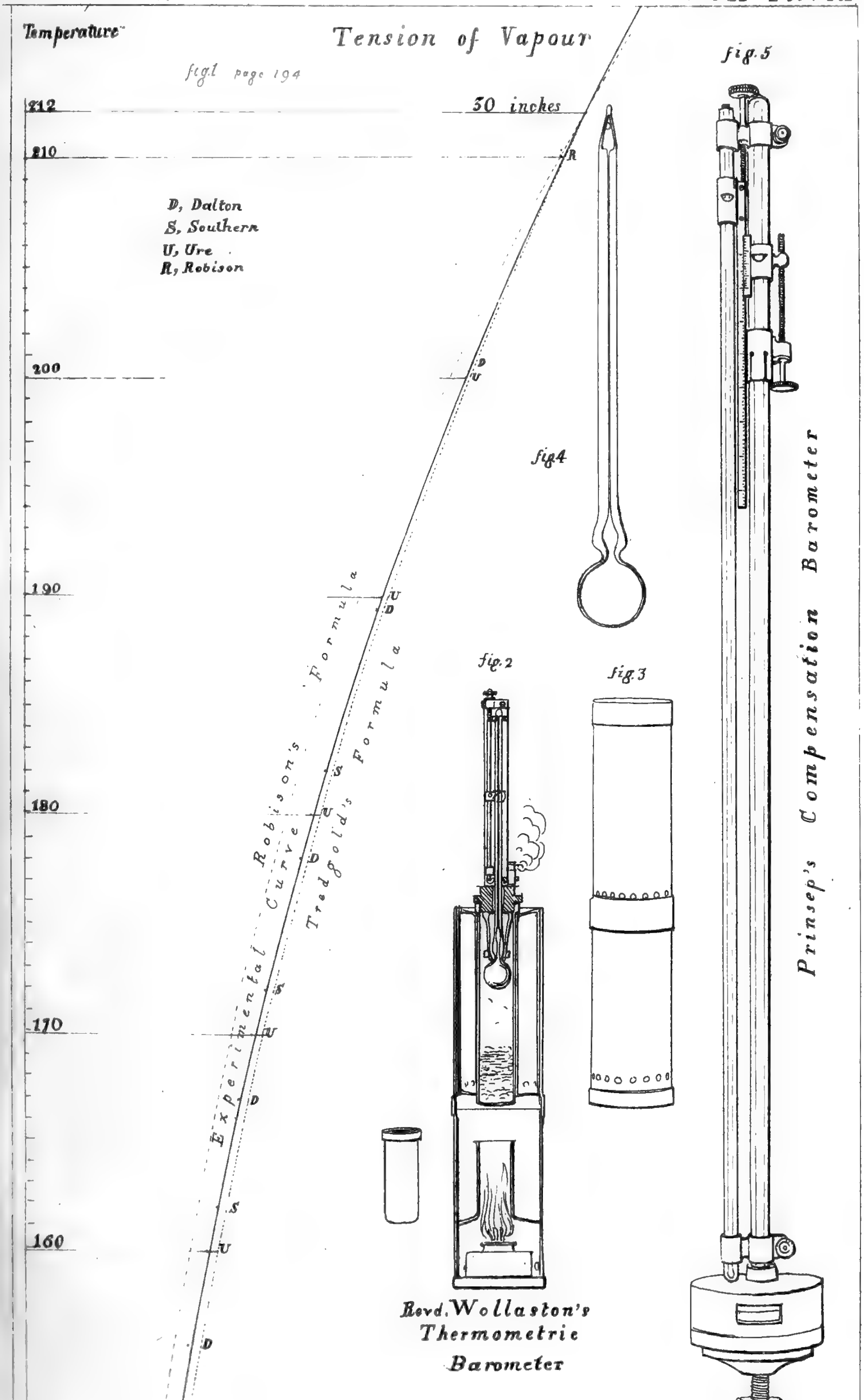
| | R. Ascension. | Declination. | N. or S. | Authority. | | Object. | Description of Object. | Constellation. | No. of Map. |
|---|---|---|---|---|---|---|---|---|---|
| | *h. m. s.* | | | | | | | | |
| 105 | 20 59 17 | 37 55 | N. | | | D. | 61 Cygni. *Binary* period about 400 years. This star has a very great proper motion in the heavens, and the two go together. | Cygnus. | 8 |
| 106 | 21 22 4 | 11 26 | N. | M. | 15 | ⊕ | In Equuleus. A fine object. | Equuleus. | 10 |
| 107 | 21 24 58 | 1 33 | S. | M. | 2 | ⊕ | A very condensed fine cluster. | Aquarius. | 16 |
| 108 | 21 37 18 | 37 10 | N. | | | | A beautiful ruby star 9 m. | Cygnus. | 10 |
| 109 | 22 19 8 | 0 55 | S. | | | D. | ζ Aquarii, 3rd class—(fine.) | Aquarius. | 16<br>10 |
| 110 | 23 17 31 | 60 38 | N. | M. | 52 | ⊕ | A beautiful cluster, 12′ diameter. | Cepheus. | 3 |
| 111 | 23 17 55 | 41 36 | N. | IV. | 18 | ○ | Superb planetary nebula in Andromeda. | Andromeda. | 4 |
| 112 | 23 30 0 | 47 36 | S. | Δ′ | 251 | D. | θ Phœnicis 6 and 6m. 3.″ | Phœnix. | 20 |
| 113 | 23 49 16 | 55 48 | N. | VI. | 30 | ⊙ | Beautiful compressed rich cluster. | Cassiopeiæ. | 4 |

## VIII.—*Description of a Compensation Barometer, and Observations on Wet Barometers. By* J. Prinsep, *Sec. &c.*

Where a daily register of the Barometer is kept, it becomes a serious labour to apply the correction for temperature to every observation: this inconvenience has led to the suppression of the correction altogether in the tables published at the Surveyor General's office; but whoever may have occasion to use these valuable meteorological records must himself reduce the indications of the Barometric columns to the freezing point, and therefore little is gained by omitting the correction in the first instance.

With a stationary barometer, in a climate liable to but small and regular alternations of atmospherical pressure, it is very easy to avoid all this labour, by attaching a compensation tube for the adjustment of the index point. I have been in the habit of using one with the instrument of which a register is kept at the Assay Office, and as it is very simple and easily made, I shall beg leave to describe it, referring to the drawing of it in fig. 3, Plate VIII.

The height of the mercurial column in a barometer depends directly upon the weight of the atmosphere, and inversely upon the density, or specific gravity, of the quicksilver, which is liable to alteration by


Temperature
Tension of Vapour
fig.1 page 194
212
30 inches
210
R
D, Dalton
S, Southern
U, Ure
R, Robison
200
190
180
170
160
150
Robison's Formula
Experimental Curve
Tredgold's Formula
fig.4
fig.5
fig.2
fig.3
Prinsep's Compensation Barometer
Revd. Wollaston's Thermometric Barometer
J. Prinsep des et sculp.

change of temperature. When the accurate pressure of the air therefore is required, the height of the column must be reduced to what it would be at some fixed temperature; and the freezing point, 32° Farh. has been universally adopted for this purpose.

Suppose, therefore, by the side of the barometer tube another truly cylindrical tube of glass to be arranged (as in the plate), closed at its lower end, and having mercury filled in to the same height as that in the barometer: it is evident that this mercurial column will expand and contract with heat and cold, (or alter its density) in the same proportion as that within the barometer itself; and if the scale of inches be connected with an index-mark or sight capable of sliding on the second—or, as it may be called, the *compensation* tube, so as to afford the means of adjustment with the variable surface of the mercury within the latter, the barometrical height will be read off at once with the requisite correction. It may be objected, that a different length of mercurial column will require a different length of compensation tube; but where, as in India, the utmost variation of the pressure does not exceed one inch, nor the variation of temperature, 40 degrees; the trifling error from this cause may be neglected; for the expansion of mercury being 0.0180 from 32° to 212°, or .0001 per degree, we have the expansion of 30 inches for 40 degrees $=.0040 \times 30 = .120.$

ditto for 29 inches, $.0040 \times 29 = .116.$

extreme difference, .004

which is not more than the usual errors of observation.

There is another point to be attended to, however, in which the celebrated meteorologist Daniell was at fault, until corrected by Gay Lussac. On account of the expansion of glass with heat, mercury will appear to expand *less* in a glass tube than it actually does expand in the proportion of $\frac{1}{648}$ to $\frac{1}{555}$*: that is, in the example given above, the expansion in the compensation tube of 30 inches long, for 40 degrees, instead of .120 will only be .103; whereas in the barometer, which is open to the cistern below, the height of the mercury is determined on hydrostatic principles, and is altogether independent of the dimensions of the glass tube. To obviate this source of error, the length of the compensation column must be increased in the above ratio of 555 to 648, or where the barometer stands on an average at 30.000 inches, the compensation column must have a length of $30 \times \frac{648}{555} = 35.0$ inches. where the mean height is 29 inches the length will be

* Many mountain barometers have an ivory scale of correction for mean expansion of mercury *and glass*, which the makers have probably copied from Daniell's original scale and have not since rectified.

| | |
|---|---|
| for 29 inches............. | 33.8 |
| 28 ditto.............. | 32.5 |
| 27 ditto............... | 31.3 &c. |

But, should such length be inconvenient, advantage may be taken of tubes that are not quite cylindrical, by placing the tapering end uppermost, and calculating the effect of the excess of mercury below upon the range of the narrower part of the column: thus, in the instrument of which the drawing is given, 32 inches was the compensating length required.

To prove that the indications of this instrument were equally trustworthy with the equated results of a common barometer, a series of comparisons was made both with the Surveyor General's standard instrument (through the medium of the printed register) and with an excellent DOLLOND's barometer placed close to mine: the results were as follows:

| | | |
|---|---|---|
| My barometer lower than Surveyor General's in June, 1832. | —.043 | |
| in March, 1833. | —.044 | |
| Ditto lower than a Dollond's barometer,....in Nov. 1832. | —.101 | |
| in April 1833. | —.102 | |
| 12 comparisons at 10 A. M. in May gave.... ......—.093 | | Therm. 86.3 |
| 10 Ditto at 4 P. M. ditto ditto.... ......—.093 | | 88.7 |

These accordances at opposite seasons of the year are sufficient to establish confidence in the *compensation barometer*. I should add, that am indebted to Mr. BARROW, H. C. Instrument maker, for carrying my views into practice, and adapting the slow-motion screws and clamps in a neat and efficient manner.

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While on the subject of barometers, I would take occasion to caution all observers who are in the habit of using ENGLEFIELD's open tubes, that they should only be filled with mercury when the air is in a very dry state. This remark was elicited by a series of experiments made by Lieutenant WAUGH of the Engineers, when comparing his stock of ENGLEFIELD barometers, with my standard, before his departure on survey to the hills of *Amerkantak*.

One tube having been filled with every precaution was found to stand 0.211 lower than the standard Barometer. It was emptied and refilled: it then stood, ............................ —.499

| | |
|---|---|
| a third time refilled, ........................ | —.609 |
| a fourth,.................................. | —.652 |
| a fifth,.................................. | —.659 |
| a sixth, .................................. | —.653 |
| a seventh, ................................ | —.700 |

an eighth,.................. .................... —.687
a ninth time,.......... ...................... —.702

It is needless to say, that in all these cases every care was taken to exclude air. It appears, therefore, that after filling two or three times, the mercurial column stood nearly .70 too low. The hygrometer at the same shewed that the aqueous tension was .60, which so nearly agreed with the former (making allowance for capillary action), that we had no doubt at the time that the depression was caused by moisture, attracted by the tube from the air, the frequent renewal of which allowed the surface of the glass to attain a state of hygrometric equilibrium with the latter. That such was the case was further proved by repeating the operation on a subsequent day, when the air was much drier; the hygrometer then shewing a tension of .45, the barometer stood between .394 and .415 lower than the standard.

It is well known how pertinaciously water adheres to the surface of glass: in damp weather an electrical machine cannot be worked unless dried by heat; and any glass tube, even in dry weather, if heated in one part, will shew the presence of water by a condensation of minute globules in the colder parts of the tube. Such facts, in conjunction with the positive testimony now adduced, prove that implicit reliance should not be placed upon this kind of barometer, especially for the measurement of heights. The different quality of the glass may also have great influence on the aqueous action, according to the predominance or otherwise of alkali in its composition.

Mr. Faraday has recommended that borax should be substituted for alkali in the composition of glass for astronomical purposes, on account of the liability of the alkaline glasses to injury by the wet, but we have not yet seen any notice of the result of such trial on a large scale. Perhaps the barometrical effect now noticed might be turned to advantage, as a mode of measuring the hygrometrical quality of glasses of different founts. Of five dry tubes of the same bore, filled together and placed upright in the same reservoir of mercury, no two were found to agree together, whereas upon wetting the interior of the same tubes, they then agreed very well together, and (after making correction for the aqueous tension corresponding to the temperature of the mercury) also very nearly coincided with the standard barometer, without any allowance for capillarity.

This circumstance suggested an easy and certain method of turning the tubes to account in the survey, namely, to use them *always wet* and make the necessary addition. The most defective and dirty tube might in this way be rendered as serviceable as the cleanest, and I would certainly recommend those who possess such tubes to use them in this manner. It is besides much easier to free them from air. All that is necessary being to fill the tubes first with water that has been well boiled, and then to pour in the mercury, allowing it to drive out the water as far as possible before inverting the tubes. The temperature must be accurately noted at the time of registering.

Lieutenant Waugh has promised me a series of observations with the wet barometer, which I hope ere long will be forthcoming.

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## IX.—*Proceedings of the Asiatic Society,*

*Wednesday Evening, 29th May,* 1833.

The Right Rev. the Lord Bishop of Calcutta, in the Chair.

The Proceedings of the last meeting were read.

Mr. W. M. Manuk, proposed by Babu Ram Comul Sen, seconded by Mr. D. Hare, was elected a Member by ballot.

Some matters of account were referred to the Committee of Papers.

The Secretary brought up the Report of the Committee of Papers, on the manuscripts of the late Mr. Moorcroft, put at the Society's disposal by Government in January last. It recommended the whole to be transmitted to England to be published, either the whole or a copious digest, on account of the Society, under the charge of Professor Wilson, who had kindly proffered his services in arranging the matter for the press before his departure. Mr. Trebeck, brother of the companion of Mr. Moorcroft's travels, had also presented the whole of his brother's journals, letters, and drawings, in order that the valuable information contained in them might be incorporated in the proposed digest, on consideration of his receiving 12 copies of the printed work. The meeting adopted the suggestion of the Committee, and an offer from Lieutenant Burnes to convey them to England was accepted with thanks.

### *Library.*

The following books were presented :

Roxburgh's Flora Indica, 1st and 2nd vols.—*by Captain James Roxburgh, on the part of himself and brother, editors of the work.*

Journal Asiatique, No. 58—*from the Asiatic Society of Paris.*

Chezy's Sacountala ; Sanskrit text and French translation—*by the Translator.*

Notice de l'ouvrage intitulé 'Lettre à M. Abel Remusat—*by the Baron Humboldt.*

* Baron Sylvestre de Sacy's Recherches, sur les contes des mille et une nuits—*by the Author.*

Ferussac's Bulletin Universel, 1827-28-29, 36 vols.—*presented by Mr. F. Corbyn, in the name of Dr. Bogie.*

* The letter accompanying the above three works was dated in 1830, they were probably detained a long time in England on their way.

Stirling's Cursory Notices on the Isle of France, 1827—*by the Author.*
Meteorological Registers for March and April—*by the Surveyor General.*

From the Society's Booksellers:—

Lardner's Cabinet Cyclopedia,—History of England, vol. iii.
Ditto ———————— Military Commanders, vol. iii.

A letter was read from Captain F. Jenkins, presenting a Burma manuscript from *Sudiya,* in the dialect of the *Kamtís,* the tribe who possess that part of Assam.

*Antiquities.*

Lieutenant Burnes exhibited to the Meeting his collection of ancient coins made between Cabúl and Bokhára, and an explanatory note was read by the Secretary.

Two papers were read by Lieutenant Burnes in further elucidation of the same subjects.

1. On the *Tope* or mound of Manikyala, and other similar *topes* in the *Panjáb.*

2. Account of a sect calling themselves the descendants of Alexander the Great in the valley of the Oxus.

[These will appear in a future number.]

*Physical.*

The following donations for the geological cabinet were presented:

1. A fragment of a large fossil bone from Jabalpúr—*by Dr. Spilsbury.*

In connection with the same subject Dr. Row writes from Benares, that he has despatched under charge of Mr. Colley a box containing a further supply of *Jabalpúr* fossil bones.

Doctor Spilsbury has since had the good fortune to make a further enviable discovery at a place about 60 miles from Jabalpúr,—the jaw of a fossil elephant with the teeth quite perfect. It remains to be seen whether this interesting specimen belongs really to the elephant or to some of the gigantic quadrupeds of the same genus brought to our knowledge by the great Cuvier; the *Mastodon* of America, which is supposed to occur in no other part of the world; the *hippopotamus* of Peru; or the *rhinoceros* of northern Asia.

Dr. Row has forwarded the section and plan alluded to by Dr. Spilsbury in his communication read to the Society at the meeting of March last.

The following specimens from Arracan—*by Mr. H. Walters, acting commissioner.*

1. Two bottles of water procured by Lieut. Mackintosh from a thermal spring found near the top of the *Aeng* pass.

2. A bottle of mineral oil or naphtha, from *Ramree.*

3. A few specimens of rocks picked up at *Ramree* and the *Aeng* pass.

4. Coal from the *Sandowy* district.

The red hill of Ramree is composed of red clay iron, enclosing nodules of steatite, of a light grey colour, black streaked steatitic iron oxyd resembling hæmatite and a conglomerate of felspar and quartz pebbles. At the foot of the hill occurs silicious breccia, which appears as if it had been an infiltration of silicious veins in the crevices of the red clay which was subsequently crumbled or washed away, the interstices being now filled with common mud.

Iron mines were worked on the island of Ramree by the Burmese, and the metal was highly prized; but it has been driven out of the field by the cheapness of English iron in all the bazars.

The limestones and corals of Arracan are deserving of attention; lime might be burnt and sent to Calcutta at a cheaper rate than that paid for the Silhet lime.

The sandstone of Ramree is of a softer nature than the best of Chunar; it resembles the Mírzapúr quarry, and is well adapted for minute and sharp sculpture.

The specimens from the *Aeng* pass are quartz rock, indurated clay, and decomposed talc-schist. A coarse granular limestone is stated to be very common in the Sandowy district.

The coal from the *Kingtellie* circle in the same district, is a very rich lignite, shewing the woody structure in great perfection: it has a spec. grav. 1.308, and gives out much bitumen and gas on ignition. The coke was small in quantity but good.—

| | | |
|---|---|---|
| Composition. | Volatile matter, ........................ | 66.4 |
| | Carbon, ................................ | 33.0 |
| | Ash, ................................... | 0.6 |
| | | 100.0 |

One specimen of coal mixed up with silicious matter is said by Mr. Walters to form the substance of an entire hill.

Of the mineral water, one bottle was found to be perfectly pure, sp. gr. 1000 and not acted on by tests: the other contained a large deposit of yellow ochreous silt.

Specimens of coal discovered in the lower range of hills in the North Moradabad district—*by Mr. E. J. Ravenshaw, collector, Bijnore.*

The following extracts from Mr. Ravenshaw's letters illustrative of this discovery, and of the presence of gold in the streams of his district were read.

*Himálayan Coal.*

"I had lately an opportunity of paying a rapid visit to the source of the coal of which I lately sent a specimen to the Society. From Judpúr, a town about 10 miles east of the *Ramgunga*, I gallopped about 18 miles to *Láldhong*, a village at the foot of the lower range of hills, and situated on the banks of the *Phika Nadi.* The latter nine miles of the road lay through the forest, which abounds with tigers, wild elephants and other animals. In the evening I proceeded on an elephant three or six miles along the foot of the hills in an easterly direction to *Mohra Dhéla,* a village situated at the point where the river *Dhéla* issues from the hills. We traced the river about a mile within the hills, and the *nyarias* (gold-washers) whom I had previously deputed to explore these regions, pointed out in several directions thin seams of coal, varying from one to four inches broad, running along between ledges of sandstone, which was covered with a white substance (decomposed pyrites?) The coal is also coated with a yellow substance (iron pyrites), and smells strongly of sulphur when burned.

About a mile up the river we came to a precipice about 200 feet high, composed of a heterogeneous mixture of sand, clay, and stones, (from the specimen sent it is a conglomerate with calcareous cement.) It was of various colours—red, bluish-green, but the white coating predominated over all.

The rains had washed down masses of the hill, and among these we found a great deal of the coal, in fact it seemed to abound here more than in any other part. The *nyarias* whom we sent up to scale the precipice, brought down their *kamarbands* full of it. The next morning I rode about four or five miles up the *Phíka Nadí,* and found the coal in similar situations, in veins stratified with sandstone, and occasionally conglomerate rocks. In the evening I explored the *Chala Nadí* to the west of the *Phika,* and found several large veins in the face of a perpendicular rock of the same description. I send specimens of the several varieties:—some appear to be mere lignite, but others are genuine coal. It is found however in such narrow veins as to give but little promise of a profitable application. The natives tell me that it is found in almost all the rivulets up to Hardwar, wherever the lower range is composed of *kacha* (unripe) materials: they call it *momyai,* and use it as a medicine for curing wounds, and as an infallible remedy for *Cholera!* for the latter purpose they pound up about half an inch square of it, and mixing it with a *lota* full of warm milk, drink it off."

The specimens of coal sent down by Mr. Ravenshaw are all nearly of the same character, strongly impregnated with sulphuret of iron, which forms thin fibres streaking some of them, and passes into thick masses of pyrites decomposing in others:—a clean lump had a specific gravity of 1.968 in consequence, and the residual ash was principally iron oxyd; it burns with good flame, does not coke, and retains sulphur enough to ignite spontaneously after being charred.

| | |
|---|---|
| Volatile matter, | 35.4 |
| Carbon, | 50.0 |
| Ferruginous ash, | 14.6 |
| | 100.0 |

*Gold**.

Mr. Ravenshaw in other communications of a recent date, mentions a discovery that all the rivers and streams descending from the same range of hills are impregnated with gold. The river in which it is most abundant is the *Koh,* which flows a few miles to the east of *Nagínah,* and falls into the *Ramgunga,* four or five miles below *Sheakdí.* "There are two parties of *nyarías* or gold-workers on this river, one at *Kot,kádír,* twelve miles from *Kot,dwar,* whence the *Koh* issues from the hills, and the other about ten miles lower down opposite to *Barapura.* At the former the *nyarías* pay 50 rupees per mensem to the *zemindár,* and at the latter 30 rupees. At *Lakherghaut* on the *Ramgunga,* about four miles from the hills, another party is established, and a fourth to the eastward at *Amangarh* on the banks of the *Phika Nadí,* a tributary of the *Ramgunga.*

* The reader will find some valuable remarks on the gold of the Ramgunga tributaries by Captain Herbert, in his notice of Himálayan minerals printed in the *Physical Researches Asiatic Society.* He notices the same curious fact of no gold being discovered in these streams until they enter the lowermost range of hills:—he also mentions having a specimen of the gold in its parent rock, but properly concludes that although we may be certain of the existence of the metal within this range, we must patiently wait until the progress of population and industry shall press upon the hitherto unexplored resources of the mountains ere we reap the advantage of our knowledge. An individual might be ruined in the search, unless indeed some lucky chance should give him a prize in the mining lottery.

In the above rivers the gold is found at all periods of the year, but in the *Dhéla*, about 10 miles to the eastward, it is only found in the rains. The *nyárias* live at *Kheloroli*, about seven miles north of *Kásipúr*; but the site of their researches is about six miles higher up the river, between *Sheonáthpúr* and the hills. A tax of 2rs. 8ans. is levied upon each *katouti* or washing-trough, which (in the absence of any other *zemindár)* is paid to Government. The gold found in this stream is said to be of a finer quality than that of any of the other rivers.

In the rivers to the eastward of the *Dhéla*, viz. the *Kosillah*, *Dabka*, &c. no gold has been discovered; I have no means of ascertaining whether it exists in the sands of the rivers in the *Barelly* district.

It is evident that these golden sands must have a source, and as they have probably flowed for centuries from the mountains it is presumable that source is extensive. The uniformity also with which it is found in all the streams from the *Ganges* to the *Kosillah* where it ceases, seems to indicate the existence of a vein of ore more or less interrupted, co-extensive with the above limits. Gold-dust is found on the other side of the *Himálaya* also: the *Bhotías* bring it with their borax from *Hundés*, where it forms the currency under the name of *phátáng*, (a small lump of gold-dust melted into a lump, value eight rupees.) I have employed an intelligent *nyaria* to search the small rivers to their source in the first or second range of hills, to wash the sand and mark where the gold-dust ceases, and to bring away specimens of the rock on either side. He is also instructed to look for coal."

A minute portion of gold is found in the sands of most rivers, but it is seldom plentiful enough to make it worth the labour of extraction. In the *Indus*, the *Irawadi*, the *Ningthi*, and the *Brahmupútra* rivers, the process of washing is practised with success, but it can only be undertaken where labour is cheap. A specimen of the washed sediment extracted from 40 maunds of the sand of the *Brahmapútra*, lately sent by Mr. W. Cracroft, weighed 396 grains; from this the magnet separated 147.3 grains of magnetic oxyd of iron: the remainder digested in boiling nitro-muriatic acid yielded 1.9 grains of gold, in value about 2½ annas.

### Specimens of the limestone rocks of *Sehwan* and of the banks of *Indus* at and east of *Tatta*, of the *Jesalmir* yellow limestone, and of the bituminous limestone of *Persepolis—by Lieut. A. Burnes.*

The limestone of the *Indus* resembles much that of the *Silhet* hills:—it appears also to contain shells: the specimen from the top of the *Sehwan* mountains is more crystalline, and of a yellow colour like that of *Jesalmír*, of which a description is given in the Gleanings, vol. iii. p. 108.

The limestone of Persepolis, used for most of the buildings of that ancient town, is of a dull brown colour and semiconchoidal fracture; it emits when rubbed a strong bituminous smell.

### Specimen of the granite of *Abu* in *Guzerat*, and of limestone between the *Oxus* and *Bokhára—by the same.*

The latter is an oolitic limestone, the first which has been discovered in India, of fine small grains about as large as mustard-seed. It is compact and capable of being quarried.

### Belemnites from the eastward of the *Aral*, and a small fossil bivalve from *Bokhára—by the same.*

The shells are converted into a solid of white marble; they are used in medicine by the Persians; the under valve is worn round as if from grinding.

Specimen of the *Indus* Coal—*by the same,* from *Kohat* near *Peshávar.*

The following note on the subject by Lieut Burnes was read:

*Peshávar Coal.*

On my arrival in the plains of *Peshávar* in March 1832, I made various inquiries from the *Doorani* chiefs of the country regarding coal and other minerals. They did not comprehend the meaning of coal, but Peer Muhamud Khan, the chief, who holds *Cohut* on the southern boundary of the plain, informed me that there were wells in the petroleum or naphtha in *Cohut,* and that the people used the substance in lamps instead of oil. He also told me that within these few months, the villagers had found that the stones near these pits were available as fuel. At my request he despatched a messenger, and brought the specimen of coal which I now present to the Society. It has been taken from the surface, and can give therefore no correct idea of the substrata further than proving that coal exists in the neighbourhood. The coal is slaty and of a greyish-brown colour, it readily ignites at the candle and emits a sulphureous smell.

The discovery of a coal-mine at the head of the *Indus* may prove of the utmost importance in these times, since the navigation of that river is open from the sea to the town of *Attok,* which is only forty miles distant from the deposit. An excellent road intervenes, and *Peshávar* is a large city where labour is cheap.

It is a singular circumstance, that coal should have been discovered both at the mouth and head of the Indus (in *Cutch* and *Cohut*) within these few years, and since steam has been used in India. It is seldom that discoveries are so well-timed, and I trust that they augur favorably for the opening of a new route of commerce by the *Indus.*

The *Indus* coal is little better than bituminous shale—slaty and dull in structure and appearance: specific gravity 1.670 : burning freely in a candle—not coking, and leaving a large quantity of brown earth on incineration. Its composition on analysis proved to be,

| | |
|---|---|
| Volatile matter, | 37.0 |
| Carbon, | 6.2 |
| Earthy matter, | 56.8 |
| | 100.0 |

It is most probable that where this shale is met with, coal of a superior quality may also be found.

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## X.—*Miscellaneous.*

### 1.—*Rustic Bridge.* Pl. X.

The accompanying is from a hasty sketch, taken in the April of 1831. It represents one of two bridges similarly constructed, which were thrown across the Jámna, at a place where that river is divided into two branches by an island. These bridges were for the convenience of communication to some iron-smelting works, situated on the right bank of the river, at some distance below the bridge erected by Major Young, where the Simla and Massúrí road crosses the Jámna.

As there is ingenuity displayed in their rough Shakesperian mode of construction, I am induced to send you this sketch, which I trust is sufficiently intelligible to supersede the necessity of a description. No rope was employed, the different parts being bound and suspended by strong twisted withes. The bridges were as may be supposed very vibratory, but were sufficiently strong to admit of the hill men carrying their loads of iron or charcoal across them with safety.

If this short notice of a somewhat ingenious and picturesque object is worth publishing in the JOURNAL OF THE ASIATIC SOCIETY, it is very much at your service.

NOTE.—We are always happy to give insertion to notices of this nature, and especially of the simple inventions and processes of the natives. In the present case, we regret that our correspondent has not given us the dimensions and span of his rustic bridge.

2.—*Remarks on the Paper on the Trisection of an Angle in No.* 14 *of the* "JOURNAL OF THE ASIATIC SOCIETY."

The difficulty of the problem is touched on in the second proposition of the paper in question, which is as follows: "To draw the base of a triangle so that of the interior angles at the base, one shall be double of the other, the vertical angle of the triangle being a given rectilinear angle, greater than half a right angle."

The construction is, to take $BF=2\,BA$, inflect $AC=3\,AB$, from the point A on B G and make $BC=BF\,\frac{1}{3}\,FC$. The writer has failed, as he admits, in his first attempted demonstration of this construction, nor in his supplementary emendation of it is he more successful. The phrase "*which it does not,*" in line 12th, and repeated in line 14th, is mere assertion; the eighteen following lines are superfluous; for if the angle K D G is a right angle, the question is settled.

A numerical example or two will perhaps be the easiest way of convincing Mr. Morrieson of his failure.

Suppose then $B=90°$ B G A is by hypothesis $30°$ and calling $AB=1$ A G will be equal to 2, and $BG=\sqrt{4-1}=\sqrt{3}=1{\cdot}7320508$; but $AC=3$, $BC=\sqrt{9-1}$
therefore $=\sqrt{8}=2{\cdot}8284271$ and $BF=2$ ~~to~~ $BC-BF={\cdot}8284271$, $\frac{1}{3}$ of which is ·2761423, and this taken from 2, leaves 1·723577, the length of B G by Lt. Morrieson's shewing; but it ought to be 1·7320508.

If B be taken=45, the limit of Mr. M.'s problem B G will come out by Mr. M.'s construction=1·65363908, but it ought to be 1·4142136.

If 60 be taken, the difference is smaller again; B G ought to be 1·53207, whereas Lt. Morrieson's construction makes it 1·542579, &c. On the whole the method is a very good mechanical rule for trisecting an angle; mathematical solution it is not. Mr. M. has hit on the difficulty in the problem which is " to draw the base of a triangle, so that of the angles at the base one shall be double of the other."—In different words, the problem comes to this, " To draw a line G A such that G D shall be equal to the radius of the circle which has B as a centre and B A as a radius," and this rule will answer in all cases where B is equal to 45. D and A coincide when greater D falls between A and G, when less D falls beyond A, and towards ~~further from~~ G′. Lou

But the problem is not to be solved by straight lines and circles: if a conchoid (pl. ix. fig. 2) having A for its pole and B C for its assymptote be described, it will cut the circle A D E in the points D, D′ and D″ and straight lines joining these points with A, or their extensions will form with B G triangles B G A, B G′ A, B G″ A, &c. of the species required. This follows from the nature of the curve, in which G D is a constant quantity, and here equal to B D the radius of A D E.

D E drawn parallel to I H gives I E an arc which measures $\frac{1}{3}$ of A B G′ D′ E′

gives H E′ which measures $\frac{1}{3}$ of A B C the supplement of the former and D″ E″ gives H E′ $=\frac{1}{3}$ A B H considered as salient at B or of $\frac{1}{3}$ (A B I + 180). The point *A′* corresponds in some degree to a pole and D, D′, and D″ if joined from an equilateral triangle, as a little consideration will shew.

*Tirhoot, 27th March,* 1833. L. D.

Capt. Alfred Burton, if I am not mistaken, employs for the trisection of an angle a cardioide of which the generating circle is E A D and the constant quantity A B. This curve at any rate answers very well, as will be evident on construction.

### 3.—*New Patent Improved Piano-Forte.*

Mr. T. Loud, jun. of Philadelphia has invented a new and useful improvement in the horizontal Piano Forte, whereby the tone is greatly improved, the instrument is less subject to get out of tune, and the strings are less liable to break, for which invention and improvement he has taken out a patent.

The improvement consists in placing either the action above the strings, or the strings and bridges turned upside down above the action. So that the hammer in striking the string shall act in the direction of the bridge, instead of as at present in an opposite direction. Upright Piano Fortes, it may be noticed, are already in possession of this improvement.—*Arcana of Science and Art.*

We are not disposed to consider this improvement (for an improvement it is, as far as *tone* is concerned) at all efficacious in preventing the instrument going out of tune. Every one who knows any thing of the Piano knows that it is by the slipping of the round iron pegs in their wooden sockets that a piano gets out of tune; the extraordinary thing is that for an evil the source of so much vexation and annoyance no remedy should have been yet discovered for, or we should rather say applied by the trade : the remedy is in reality as obvious, as is the interest of that trade to avoid applying it. We have seen the piano of a gentleman in Calcutta much strengthened and improved by the adaptation of a cast-iron case to the front block in which the pegs are inserted; in fact if the whole frame could be made of a triangle of cast-iron, the piano would be infinitely more durable than it is at present, although it is probable that its tone might be prejudiced.

We must confess, however, that within the last few years, many real improvements have been introduced in the adaptation of the Piano to the vicissitudes of our Indian climate: the metal bars, thrown across in the direction of the strain, tend materially to prevent the instrument form warping, and by themselves expanding and contracting with heat and cold in the same ratio nearly as the wires, they keep the latter under an uniform tension, and consequently always in tune; whereas those Pianos, which depend upon a wooden frame alone, require to be tuned with every change of weather. Another real improvement in small Pianos has been the introduction of the metal plate, to which all the wires are attached : the advantages gained by this construction are twofold, the sounding board is left free underneath, and the strings of the upper octaves are deprived of that long neutral space between the fixed pegs and the bridge, which always caused the upper notes of these instruments to flatten much faster than the lower octaves. In fact, the liability to stretch or slip, and the chance of flaws or imperfection of elasticity (which are the only causes of getting out of tune), being in direct proportion to the length of wire, every wire should have the same proportion beyond the bridge to maintain uniform tune. Some makers have ingeniously made use of the tail pieces of the wires, in grand pianos, to produce a doubling of the tone; the wires beyond the bridge have precisely the same length to the fixed pegs as before the bridge, or within the action : on raising by means of a pedal the damper that usually covers them, the sound will be doubled by the reciprocal vibration of the extra strings: the thought has much ingenuity, and all that can be urged against it is that the bulk of the instrument is somewhat increased, and with it the chances of derangement and getting out of tune.

### 4.—*Specific Gravity of Metallic Alloys.*

In the second number of Brewster's Journal N. S. are some curious results obtained in experiments on the melting points and densities of different alloys, by M. Kupffer. It appears that in every proportion of tin and lead from one of tin with one of lead, to one of tin with four of lead, and from one of tin one of lead to six of tin one of lead, there was expansion, i. e. the specific gravity of the alloy was found to be less than that given by calculation. At two of tin one of lead, and still more at three of tin one of lead, the difference was trifling; and as the difference increased each way it was conjectured that at some intermediate proportion between those two, the resulting specific gravity would agree with the calculation. It was found that *one volume* of lead to *two* of tin gave a specific gravity almost exactly that of calculation.

In amalgams of tin and mercury, again, contraction was found to take place; it being null when one combining volume of tin was added to two of mercury. In amalgams of lead and mercury the least contraction is found when one combining volume of lead is united to three of mercury.

The following melting points were observed:

| | *Centigrade* | *Fahrenheit.* |
|---|---|---|
| Lead,........................................ | 334° | 633.2 |
| Tin, ........................................ | 230 | 466 |
| Tin 5 primes, Lead 1 prime, .............. | 194 | 381.2 |
| 4 " 1 " .............. | 189 | 362.2 |
| 3 " 1 " .............. | 186 | 356.8 |
| 2 " 1 " .............. | 196 | 384.8 |
| 1 " 1 " .............. | 241 | 365.8 |
| 1 " 3 " .............. | 289 | 452.2 |
| 2 volumes, 1 volume,.............. | 194 | 381.2 |

These temperatures were determined by noting the weight of mercury driven out of a small bulb furnished with a capillary tube, in the same manner as practised by Messrs. Dulong and Petit. They will therefore require some correction. D.

### 5.—*Proportion of Recent and Fossil Shells.*

The following notice of the numbers of known species of recent Testaceous Mollusca and of Fossil shells is taken from Loudon's Magazine of Natural History.

| | Simple univalves | Bivalves and multivalves. | Multilocular univalves | Total. |
|---|---|---|---|---|
| Testaceous Mullusca of the present world, | 1961 | 874 | 58 | 2893 |
| Species of British Fossil shells, ........ | 401 | 634 | 230 | 1265 |
| Of the 1265 Fossil Species, the following is the distribution. | | | | |
| 1st Division, 1st Section, Carboniferous order of Mr. Conybeare, ............ | 27 | 80 | 33 | 140 |
| 1st Division, 2nd Section, to the Lias inclusive, .......................... | 9 | 38 | 50 | 97 |
| 2nd Division, from the Lias upward to the Chalk inclusive,.................. | 106 | 375 | 139 | 620 |
| 3rd Division, Tertiary Beds above the Chalk,............................ | 259 | 141 | 8 | 408 |

The author of this paper draws the conclusion " that in proportion as we descend the vast series of deposits that overspread this portion of the earth, so do we recede, step by step, from the circle of existing organised beings, and from the phenomena attendant on their structure, their habits, and their adaptations." D.

6.—*Table of the Lengths in British Miles of the Degrees of Latitude and Longitude from 0°. to 30°. with the Areas bounded by them in Square Miles.*

| Parallels of Lat. | No. of miles in a Meridional Degree. | Mean. | *a* Logarithm | No. of miles in a Longitudinal Degree | Mean. | *b* Logarithm | Sums of $a+b$ | Nat. number. Square miles. |
|---|---|---|---|---|---|---|---|---|
| 8° | 68.7160 | | | 68.4870 | | | | |
| | | 68.7177 | 1.8370705 | | 68.3983 | 1.8350434 | 3.6721139 | 4700 |
| 9 | 68.7195 | | | 68.3097 | | | | |
| | | 68.7214 | 1.8370895 | | 68.2107 | 1.8338544 | 3.6709439 | 4687 |
| 10 | 68.7233 | | | 68.1118 | | | | |
| | | 68.7254 | 1.8371147 | | 68.0025 | 1.8325217 | 3.6696364 | 4673 |
| 11 | 68.7276 | | | 67.8933 | | | | |
| | | 68.7298 | 1.8371463 | | 67.7736 | 1.8310631 | 3.6682094 | 4658 |
| 12 | 68.7321 | | | 67.6540 | | | | |
| | | 68.7346 | 1.8371779 | | 67.5242 | 1.8294582 | 3.6666361 | 4641 |
| 13 | 68.7372 | | | 67.3944 | | | | |
| | | 68.7398 | 1.8372095 | | 67.2543 | 1.8277181 | 3.6649276 | 4623 |
| 14 | 68.7425 | | | 67.1143 | | | | |
| | | 68.7453 | 1.8372411 | | 66.9641 | 1.8258414 | 3.6630825 | 4603 |
| 15 | 68.7482 | | | 66.8139 | | | | |
| | | 68.7512 | 1.8372790 | | 66.6536 | 1.8238262 | 3.6611052 | 4582 |
| 16 | 68.7543 | | | 66.4933 | | | | |
| | | 68.7574 | 1.8373169 | | 66.3229 | 1.8216642 | 3.6589811 | 4560 |
| 17 | 68.7606 | | | 66.1525 | | | | |
| | | 68.7640 | 1.8373611 | | 65.9720 | 1.8193597 | 3.6567208 | 4536 |
| 18 | 68.7675 | | | 65.7915 | | | | |
| | | 68.7710 | 1.8374053 | | 65.6010 | 1.8169105 | 3.6543158 | 4511 |
| 19 | 68.7745 | | | 65.4106 | | | | |
| | | 68.7782 | 1.8374495 | | 65.2103 | 1.8143142 | 3.6517637 | 4485 |
| 20 | 68.7820 | | | 65.0100 | | | | |
| | | 68.7858 | 1.8375001 | | 64.7998 | 1.8115750 | 3.6490751 | 4457 |
| 21 | 68.7897 | | | 64.5896 | | | | |
| | | 68.7937 | 1.8375506 | | 64.3695 | 1.8086768 | 3.6462274 | 4428 |
| 22 | 68.7977 | | | 64.1495 | | | | |
| | | 68.8019 | 1.8376011 | | 63.9197 | 1.8056368 | 3.6432379 | 4398 |
| 23 | 68.8061 | | | 63.6900 | | | | |
| | | 68.8104 | 1.8376516 | | 63.4505 | 1.8024316 | 3.6400832 | 4366 |
| 24 | 68.8147 | | | 63.2111 | | | | |
| | | 68.8191 | 1.8377084 | | 62.9620 | 1.7990785 | 3.6367869 | 4333 |
| 25 | 68.8236 | | | 62.7130 | | | | |
| | | 68.8282 | 1.8377652 | | 62.4544 | 1.7955603 | 3.6333255 | 4298 |
| 26 | 68.8328 | | | 62.1959 | | | | |
| | | 68.8375 | 1.8378219 | | 61.9278 | 1.7918871 | 3.6297090 | 4263 |
| 27 | 68.8422 | | | 61.6597 | | | | |
| | | 68.8470 | 1.8378850 | | 61.3823 | 1.7880410 | 3.6259260 | 4226 |
| 28 | 68.8519 | | | 61.1050 | | | | |
| | | 68.8568 | 1.8379481 | | 60.8183 | 1.7840321 | 3.6219802 | 4188 |
| 29 | 68.8618 | | | 60.5316 | | | | |
| | | 68.8669 | 1.8380112 | | 60.2356 | 1.7798561 | 3.6178673 | 4148 |
| 30 | 68.8720 | | | 59.9396 | | | | |

*Note.*—The above table was compiled in the Surveyor General's Office, and will be found of great use to Revenue Surveyors, &c. as it comprehends the latitude of all parts of the plain of India.

## Meteorological Register, kept at the Assay Office, Calcutta, for the month of May, 1833.

| Day of the month. | Barometer reduced to 32° Farh. At 4½ A.M. | At 10 A.M. | At 4 P.M. | At 10 P.M. | Thermometer in the Air. Minimum at 4½ A.M. | At 10 A.M. | Max. by Reg. Ther. | At 4 P.M. | At 10 P.M. | Depression of moist-bulb Thermometer. At 4½ A.M. | At 10 A.M. | At 4 P.M. | At 10 P.M. | Hair Hygrometer. At 10 A.M. | At 4 P.M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ,642 | ,693 | ,589 | ,635 | 86,5 | 89,4 | 96,8 | 92,8 | 83,2 | 4,6 | 6,5 | 8,4 | 4,9 | 92 | 89 | | e. | e. | S. | clear. | clear. | hazy. |
| 2 | ,587 | ,664 | ,534 | ,644 | 80, | 89,5 | 98, | 92,8 | 81,7 | 1,4 | 6,4 | 8,7 | 5,3 | 92 | 89 | | s. | s. | E. | scud. | do | storm. |
| 3 | ,605 | ,690 | ,568 | ,661 | 82,1 | 89,5 | 97, | 93,0 | 84,3 | 4,0 | 6,5 | 9,3 | 5,9 | 92 | 88 | | o. | S. | S. | overcast. | do | overcast. |
| 4 | ,606 | ,654 | ,550 | ,624 | 83,2 | 89,6 | 96,5 | 92,7 | 85,3 | 5,9 | 7,0 | 8,5 | 6,9 | 91 | 89 | | s. e. | s. | S. | do | do | heavy scud. |
| 5 | ,641 | ,716 | ,569 | ,803 | 83,2 | 90,5 | 98, | 91,8 | 72,4 | 5,1 | 7,7 | 10,2 | 1,2 | 89 | 86 | | s. e. | s. | N. W. | clear. | clouds | heavy rain |
| 6 | ,740 | ,861 | ,765 | ,796 | 72,6 | 82,6 | 80, | 81,7 | 75,7 | 2,9 | 6,5 | 5,7 | 2,3 | 90 | 95 | 1,64 | N. | N. E. | N. | cum. str. | rain | cir. cum. |
| 7 | ,686 | ,802 | ,685 | ,800 | 73,4 | 82,7 | 90, | 85,8 | 80,0 | 1,6 | 5,0 | 7,5 | 5,2 | 96 | 89 | | n. | o. | o. | haze. | clear. | clear. |
| 8 | ,784 | ,837 | ,728 | ,854 | 80,0 | 86,3 | 93, | 87,8 | 78,3 | 3,0 | 6,5 | 10,3 | 5,3 | 92 | 85 | | o. | o. | S. | do | do | do |
| 9 | ,779 | ,802 | ,740 | ,795 | 71,0 | 85,7 | 93,3 | 88,4 | 81,2 | 4,2 | 10,0 | 10,5 | 3,7 | 80 | 84 | | n. | s. | o. | cloudy. | do | do |
| 10 | ,788 | ,814 | ,680 | ,732 | 78,0 | 86,1 | 94, | 90,2 | 81,2 | 3,0 | 7,5 | 10,7 | 4,8 | 89 | 85 | | o. | s. w. | S. | do | do | do |
| 11 | ,727 | ,776 | ,676 | ,754 | 80,0 | 88,2 | 95,3 | 90,9 | 83,0 | 3,2 | 9,5 | 13,0 | 5,3 | 86 | 79 | | o. | s. | S. | clear. | do | do |
| 12 | ,730 | ,793 | ,644 | ,672 | 81,0 | 88,7 | 96,7 | 92,0 | 83,8 | 3,7 | 6,8 | 10,0 | 5,7 | 90 | 86 | | E. | S. | S. | do | do | do |
| 13 | ,737 | ,723 | ,622 | ,718 | 80,2 | 88,3 | 97,5 | 93,4 | 84,0 | 2,0 | 6,8 | 10,8 | 5,4 | 91 | 84 | | s. | S. | S. | do | do | lightning s. e. |
| 14 | ,593 | ,738 | ,663 | ,656 | 73,1 | 89,1 | 105, | 89,7 | 78,0 | 2,5 | 9,3 | 7,4 | 2,3 | 88 | 91 | | s. | s. e. | e. | do | rain. | clear. |
| 15 | ,682 | ,730 | ,594 | ,658 | 78,2 | 87,5 | 94,2 | 91,2 | 82,8 | 3,0 | 6,5 | 9,0 | 4,0 | 91 | 88 | 2,00 | o. | o. | s. | nimbi. | clear. | do |
| 16 | ,642 | ,714 | ,593 | ,686 | 81,0 | 88,0 | 95, | 90,4 | 82,0 | 2,6 | 6,7 | 10,5 | 5,6 | 91 | 84 | | s. | s. | o. | cumuli. | cumuli. | cumuli. |
| 17 | ,651 | ,663 | ,556 | ,631 | 80,1 | 89,0 | 95,8 | 92,7 | 83,2 | 2,9 | 7,5 | 10,6 | 5,8 | 90 | 85 | | s. | o. | s. | clear | do | clear. |
| 18 | ,579 | ,654 | ,504 | ,592 | 80,1 | 89,7 | 95,7 | 91,3 | 84,0 | 2,5 | 8,2 | 10,4 | 5,4 | 88 | 85 | | o. | o. | s. | do | do | do |
| 19 | ,548 | ,600 | ,500 | ,551 | 81,6 | 89,0 | 93, | 91,0 | 83,0 | 2,6 | 6,5 | 10,0 | 5,0 | 90 | 85 | | o. | o. | o. | do | do | do |
| 20 | ,482 | ,528 | ,376 | ,400 | 80,1 | 85,0 | 88, | 87,3 | 81, | 3,1 | 6,5 | 7,2 | 3,8 | 95 | 89 | 0,98 | N. | N. | N. | cir-cum. | rain. | threatening |
| 21 | ,233 | ,086 | ,868 | ,076 | 78,0 | 82,2 | 85, | 82,8 | 80, | 2,0 | 3,6 | 8,6 | 4,0 | 98 | 98 | 2,90 | NE. | N. E. | S. E. | gale | and rain. | violentgusts |
| 22 | ,188 | ,303 | ,300 | ,407 | 79,5 | 82,5 | 87,5 | 84,3 | 83,1 | 4,1 | 4,0 | 4,0 | 7,1 | 95 | 96 | 5,34 | S. | s. | s. | rain. | lowering. | cloudy. |
| 23 | ,425 | ,494 | ,425 | ,491 | 82,2 | 83,7 | 90,3 | 84,8 | 82,2 | 4,1 | 2,3 | 4,3 | 3,7 | 98 | 94 | | S. | s. | o. | steam | f. ground. | o'rpwring. |
| 24 | ,399 | ,391 | ,340 | ,402 | 83,3 | 88,7 | 95,8 | 87,9 | 88,1 | 1,5 | 4,4 | 3,5 | 3,9 | 96 | 97 | | s. | s.w. | o. | do | and | calm stratus. |
| 25 | ,364 | ,400 | ,369 | ,466 | 85,0 | 87,0 | 97,5 | 89,2 | 88,9 | 2,0 | 2,6 | 3,5 | 4.9 | 98 | 96 | | o. | o. | s. | haze | all | day. |
| 26 | ,439 | ,496 | ,442 | ,525 | 85,0 | 87,7 | 98, | 89,8 | 88,1 | 2,3 | 2,8 | 3,2 | 6,3 | 98 | 97 | | o. | s. | n. | do | do | do |
| 27 | ,486 | ,496 | ,408 | ,470 | 84,1 | 88,5 | 98, | 92,2 | 87,4 | 2,7 | 3,5 | 4,7 | 5,9 | 97 | 96 | | n. e. | S. | s. | clear. | cumuli | stratus. |
| 28 | ,431 | ,472 | ,338 | ,439 | 86,4 | 89,3 | 97, | 90,5 | 87,3 | 4,7 | 4,0 | 4,0 | 3,7 | 95 | 97 | | S. | S. | S. | haze. | cum. cir. | cumulus |
| 29 | ,409 | ,468 | ,400 | ,466 | 87,2 | 89,7 | 98, | 92,8 | 87,0 | 6,2 | 4,7 | 6,7 | 4,0 | 95 | 92 | | S. | S. | S. | nimbus | do | do |
| 30 | ,435 | ,521 | ,441 | ,510 | 87,2 | 89,7 | 99, | 92,8 | 87,0 | 6,5 | 6,3 | 6,8 | 4,0 | 93 | 92 | | S. | s. | S. | nimbi. | do | cirri. |
| 31 | ,455 | ,504 | ,426 | ,472 | 86,8 | 90,4 | 99, | 95,2 | 87,0 | 6,7 | 5,5 | 8,5 | 4,0 | 94 | 89 | | S. | s. | S. | cumuli. | do | do |
| Means, | ,565 | ,617 | ,5[illegible] | ,593 | 80,8 | 87,5 | 94,0 | 90,0 | 83, | 3,4 | 6,1 | 8,2 | 4,8 | 95 | 90 | 12,86 | variable. | | | oppressive heat and damp. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory, and the Sunday entries are filled in by interpolation. The Instruments for 5 A. M. and 10 P. M. are observed daily in the south veranda of a house near the Cathedral. On the 21st, a hurricane overwhelmed Saugur and Kedgeree, inundating the whole country and destroying very many lives. The Barometer experienced an unprecedented fall at Calcutta, having descended to 28, 867 in. at 4½ P. M. of the 21st; after that hour, it rose gradually, and the strength of the gale occurred as usual during the rise.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 18.—*June,* 1833.


### I.—*On the Marriage Rites and Usages of the Játs of Bharatpur.* *By* G. T. Lushington, *Esq. C. S.*

[Read at the Meeting of the Asiatic Society, March 27, 1833.]

In the month of May, 1832, the present Raja of *Bharatpur**, Balwant Singh, was married to a daughter of the *Bechore* Raja, a Jât chief, of a very respectable family residing near *Gwalior.*

Though there is no mention of the *Bechore* Rajas in the "*Ayeen Akberi,*" nor in any English work on India, that I am acquainted with, I am assured by the *Bharatpur* ministers and other respectable natives that the *Bechore* Princes once possessed territories in the neighbourhood of *Gwalior,* which yielded an annual revenue of from three to four lakhs of rupees. They add that the greater part of these territories are now in the hands of the Sindia family, and that the present *Bechore* Raja has only a small *Jagír* of about fifteen thousand rupees per annum.

The *Bharatpur* Raja was betrothed in 1824 (*Samvat* 1881), to the *Bechore* Princess, by his father, the late Baldeo Singh, and under ordinary circumstances the marriage would have been solemnized many years ago. The Hindú law indeed censures the delay of marriage (for females) beyond 10 years, but the *Bharatpur* Jâts as "*Baran-Sankárs* or a mixed caste, deriving their origin† and military habits

* Then 14 years of age.

† Such is the tradition of the *Bharatpur* Jâts themselves. They assert their (spurious) descent from the famous or fabulous Bijei Pal of *Biána,* regarding whose power, riches, and extent of dominion, many *curious* tales are still current among them. In the "Bijei-Pal Rasa," a metrical romance or ballad (written in *Brij Bhakha*), the Hindú scholar will find a full and particular account of this

from the Lunar *(Chandravansí)* race of Rajpúts, and possessing at the same time the patient industry, agricultural skill, and religious laxity of the *Súdra* or servile classes, do not strictly adhere to the minutiæ of Hindú law. Whilst they retain many parts of the ancient ritual they omit others, and substitute in their place peculiar forms and usages (as will be noticed hereafter), which though evident innovations are held, by them, in the highest esteem.

But in this particular case the delay alluded to arose not from Jât laxity. It was owing in the first place to the untimely death of the late Raja Baldeo Singh, and the troubles arising out of that event, which were terminated only by the capture of *Bharatpur*, in January 1826, and the restoration of his son Balwant Singh, a minor, to the *masnad;* and secondly, to the domestic intrigues and contentions which took place at the capital between the *Májí* or *Rani* mother and the Regent ministers, as to the selection of a *Gúrú* or spiritual adviser for the young Raja. The *Mají* is eldest wife of the late Raja, and step-mother of the present Raja; and as she once had the reputation of possessing some ability, the Supreme Government nominated her in the first instance to the office of Regent.

Her subsequent conduct however speedily did away with the favorable opinion entertained of her. It soon became evident that any portion of talent or acuteness which she might once have possessed, was neutralised by the lasting effects of a vicious education, and by a more than ordinary share of feminine caprice and weakness. Being naturally of a violent and imperious temper the possession of power appeared, day by day, to strengthen and augment the worst features of her character, until it at last led her to the commission of acts alike injurious to her own reputation and fatal to the interests confided to her.

Remonstrances and exhortations having been in vain addressed to her by the British Government, it became necessary to place the administration of *Bharatpur* affairs in other hands. The *Rani* was accordingly removed from the office of Regent, (a suitable establish-

great Hindú monarch, who is *fabled* to have conquered Raja Jomeswar, the father of Pirthu Raj, the celebrated *Chouhan* king of *Delhi*, and to have ruled despotically over the *whole* of India. The Keroli* Raja too, boasts his descent from Bijei Pal, and if any faith can be placed in a "*Bansaolí*" or genealogical "tree," he has a fair claim to the benefits, real or imaginary, resulting therefrom. Abulfazl has a short and pithy sentence regarding the "*Bansaolis.*" "And all of these tribes now carry in their hands genealogical tables for ages back."—*Gladwin's Ayeen Akberi*, vol. ii. p. 399.

* He is a *Chandravansi Rajpút.*

ment being assigned her in the *Mehál* or inner apartments,) and the old ministers of the Raja appointed to succeed her. Of these, the *Dewán*, or principal minister, Jewahir Lal, was fortunately a person of considerable knowledge and experience in business, having held the *Dewáni* with distinguished honor to himself and advantage to the state during the reign of Ranjit, Ramdhan, and Baldeo Singh. By his prudent and equitable measures tranquillity was speedily restored and the old system of management re-established.

But though the *Rani*, as above stated, had been formally removed from the Regency, she never relinquished her hopes of a return to power. After repeatedly attempting to blacken the character of the Regent ministers, and as often failing in her attempts, as the charges advanced by her proved on investigation to be entirely groundless, she determined to change her plan of attack, and to apply all the means at her disposal to the establishing such an influence on the mind of the young Prince as would eventually throw him into her hands. With a view to this end she revived a story which she had herself invented and circulated when Regent, of the Raja's initiatory necklace* having been tied on by a favourite priest and emissary of her own, by name Sri' Ram; and on the strength of this story, she asserted the right of this person to be elected *Gúrú* or spiritual adviser to the Raja, well knowing that if she could effect this object, she would secure to herself the greatest spiritual and political influence, and become de facto mistress of the state.

The Regent ministers on the other hand had from the first attested that the pretensions of *Parohit* Sri' Ram to the Gúrúship were altogether false and ridiculous; that the father of the Raja had actually selected as *Gúrú* for his child the superior of the very temple of which this Sri' Ram was the mere *Pújarí* or officiating priest; that, the circumstance of Sri' Ram's being a *Pújarí* was a sufficient refutation of his claim; as the *Mehant* or superior of a temple, alone, was qualified for the office of *Gúrú*; and that in addition to these proofs, Hari Das, the superior in question, was still living, and deposed that he had tied on the necklace with his own hands during the life time, and in the presence of Baldeo Singh.

* The ceremony of tying on the necklace is performed when the *Gúrú* is selected; the *Chéla*, or disciple, being then an infant. This is preparatory, and intended to show that a selection has been made. When the disciple has arrived at the prescribed age, the ceremony of initiation is completed by the *Gúrú's* pronouncing the "*Gúr Mantra*," or mystical charm in the ears of the *Chéla*, who thereby becomes a twice-born, or regenerated man.

To this statement, a flat denial was given by the *Rani* and her favourite priest, and amidst the bickerings and intrigues that ensued, the Raja's marriage was for some years considered inexpedient; it being contrary to usage that a person should be married prior to the ceremony of investiture being completed by his *Gúrú's* pronouncing the *Gúr Mantra*, or mystical words of initiation.

Such was the state of this question up to the beginning of 1832, when the advancing years of the young Prince convinced the regent ministers that a further delay would only tend to "defer* the remedy of the evil, not the evil itself," and that some decision must be forthwith resolved on;—after much doubt and hesitation they determined to solemnize the marriage, leaving the choice of a *Gúrú* to be decided on by the Prince himself on his attaining his majority. Before venturing on so unusual a proceeding, an opinion was obtained from the Brahmans, that though it would doubtless have been proper for the Prince to have become the disciple of some *Gúrú* previously to entering upon the holy state of matrimony, still it would be better for him to marry at once, and afterwards select a *Gúrú*, than continue in his unhallowed state of celibacy.

At the same time it was decided that the marriage ceremonies should be solemnized at the town of *Díg*† (24 miles to the north of *Bharatpur*), that the bridegroom should go out thus far to meet the bride, and after the performance of the ceremonies, conduct her to his palace at *Bharatpur*.

It has been stated above that the Raja was betrothed in the year 1824, and I now proceed to describe the manner in which the betrothal (*Sugaí*) takes place. I am well aware that in doing so I run the risk of wearying the patience of the reader. But it is necessary in this as in other things to begin with the beginning; neither am I ignorant that the ceremonies which form the subject of this paper have been pronounced by the historian of British India (see vol. 1. note c.), to be "trivial, multiplied, and tiresome." Such they would doubtless appear to be to the philosopher and historian of Europe, who, calmly seated in his study some thousands of miles from the country in which these customs obtain, looks with wonder or contempt at the

* Remedia potius malorum quam mala ipsa differentes.—*Tacitus.*

† The "*Bhowans*" or garden-palaces of *Díg*, built by the celebrated Jât, SU'RAJ MUL, may safely be compared with any of the buildings erected by the Muhammedans at Delhi or Agra. They were constructed of the stone found in the *Rúpbas* hills about 80 years ago. For a short account of the antiquities of *Díg*, see Appendix, A.

"trivial and multiplied" details, and in sorrow or anger records his opinion of their absurdity. But the Hindú, alas! looks upon these very *absurdities* in a totally different light—he considers them as part and parcel of his religion, as forms which were in the first instance inculcated by his deities, and which the practice and veneration of ages has hallowed. We may lament that he should do so, but we ought not surely to condemn him without inquiry. It appears to me that some of these very ceremonies, of which so sweeping a condemnation has been passed, are not only interesting and curious, but even valuable, inasmuch as they tend to throw light* upon the feelings and domestic genius of our subjects.

The betrothal takes place in the following manner—a message is first sent by the father of the girl to the bridegroom's father, intimating that as alliances have formerly taken place between their families, and as Providence has kindly blessed him with a daughter, &c. he is anxious to bind the knots of amity closer than ever. Should the father of the boy approve of the suggestion, he dispatches a *Parohit* or family priest to the lady's father, both to measure the height of the girl and ascertain her personal appearance, &c. On the return of the *Parohit* to his employer, the height of the young lady is compared with that of the boy. Should it appear to be of the orthodox proportion, and the report made by the *Parohit* of her beauty be favourable, the genealogies and affinity of the parties are then inquired into; and in the event of their not coming within the† prohibited degrees, the betrothal is agreed to, and considered binding upon both parties.

The betrothal having been adjusted, and the *Tika* or marriage present sent by the bride to the bridegroom, it remains for the Brahmans to select what they may be pleased to consider a "fortunate hour" for the marriage. Regarding this important point, long and tiresome disputes are sometimes carried on between the astrologers of the two

* "We cannot," says the talented and discriminating Sir H. Strachey, "study the genius of the people in its own sphere of action. We know little of their *domestic life*, their knowledge, conversation, amusements; their trades and castes, or any of those national and individual characteristics which are essential to a complete knowledge of them." Perhaps the acknowledged existence of this lamentable defect may excuse the attempt on my part to illustrate one of the most important events in the life of a Hindú.

† The prohibited degrees among the *Bharatpur* Jâts are the *Gots* or families of the boy's paternal and maternal grand-fathers and grand-mothers. In this, as in many other points, they depart widely from the strictness of the Hindú system as promulgated in the "Institutes of Menu'," where prohibitions of the most extraordinary nature are enumerated, and directions for choosing a wife minutely laid down.

durbars. These disputes would indeed be endless but for the interference of the superior party, who may always command or obtain the silence of the priests by a well-timed fee, or the promise of a grant of land. All opposition then ceases; difficulties and scruples founded upon texts from the sacred writings vanish, as soon as the land of promise appears in sight : a little ingenuity and a considerable portion of hardihood is all that is required; for with the aid of these two auxiliaries the very *Shastras* which at first appeared to condemn the arrangement may be clearly shown to favour it. There is an especial advantage in this sort of arrangement to the soothsaying Brahmans. Should the *Mohrat* prove a fortunate one, they take good care to attribute all the happy results following it to the skill with which it was arranged by them, but if on the other hand any untoward events should happen; if for instance the bride should prove barren or prolific only in female* children, they represent that they had from the first had a divine presentiment of the evil, but yielding to the opinion attempted by the anger of the Prince had consented to fix the *Mohrat* agreeably to his wishes.

As before stated, many years elapse between the act of betrothal and the celebration of the marriage rites. It is however expedient that the number of years thus intervening should constitute an uneven sum, as 3, 5, 7, not 2, 4, 6, which would be deemed unlucky. A similar belief in the virtue of uneven numbers has obtained amongst many nations from the earliest ages. It is especially laid down in the astrological books of the Hindús. Thus in the *Mohrat-Chintaman,* (a book abounding in the most extraordinary absurdities,) it is written that it is always fortunate to meet the black antelope on the right-hand side, and if the number of antelopes be *odd,* it is even fortunate to meet them on the left side. A bad omen occurring to a person starting on a journey is removed by eleven inspirations, and twenty-five steps with the right foot should then be taken. Perhaps this belief may have given rise to the Hindú Triad, and triliteral monosyllable for the three worlds—earth, sky, and heaven. The number three being

* There is a curious passage in the Koran, illustrative of the feeling which prevailed among the Pagan Arabs on the subject of female offspring: see SALE's Koran, c. 16. "And when any of them is told the news of the birth of a female, his face becometh black, and he is deeply afflicted ; he hideth himself from the people, because of the ill tidings which have been told him, considering with himself whether he *shall keep it with disgrace,* or *whether he shall bury it in the dust.*" The feeling led, in Arabia as in India, to the crime of infanticide. It was formerly practised by many of the Rajpúts and by the Játs. I wish I could persuade myself that it has ceased.

uneven, and as such supposed to be of especial sanctity. At any rate, wherever or however the belief originated, it was at one time prevalent throughout the world. Even the Platonists appear to have inclined to it, and it was certainly esteemed by the other philosophical sects—nor is it perhaps much more absurd than the belief in alchemy, which formerly mastered the intellects of the sages and philosophers of Christendom, and for a time at least is supposed to have influenced the sublime genius of NEWTON*.

The time for the marriage having thus been fixed, the day on which the *lagan-patri* (or letter containing the marriage horoscope) shall be sent by the bride to the bridegroom, is then adjusted. This is brought by the *Parohit* or family priest of the bride's father, and is simply a large scroll of paper, on which the day fixed on for the wedding, the aspect of the planets, the number of days during which the bridegroom's body is to be anointed with jasmine oil (*Chambéli-ka-tél*), and the number of rejoicings (*mangal*) or days during which the ceremony is to last, are specified.

The *lagan* is written in Sanscrit, and together with the *khilat* which accompanies it, is received by the Raja in the inner apartments, on which occasion none but the females of the family, the Brahmans and *Parohits* (who have always access to the *mehal*), and Raja himself are present.

The *lagan-patri* having been brought by the *Parohit* to the Raja, the latter places it on his head, in token of respect, and delivers it to the Brahmans in attendance, who read and explain its contents. The Raja is then lifted† up by the *naí* ‡ in waiting, and carried into the inner apartments, where the *Májí* or *Rani* mother resides, and to her he gives the *lagan-patri* and *khilat* which accompanied it. I should have stated above, that the *lagan* is tied up with *yellow*§

* Not less extraordinary was the *enthusiastic* belief of the Emperor JULIAN, the hero, legislator, and *philosopher*, in the virtue of the Eleusynian Mysteries and Grecian arts of divination. GIBBON observes, with his usual felicity of expression, "By a strange contradiction, he disdained the salutary yoke of the Gospel, whilst he made a voluntary offering of his reason on the altars of Jupiter and Apollo." *Decline and Fall*, chapter xxiii.

With regard to Sir J. NEWTON's belief in the doctrines of alchemy, I observe that Sir D. BREWSTER, in his lately published Life, (page 302,) states, that there is no reason to suppose that Sir I. N. did *believe* in them

† He is *lifted* up, because it is considered improper that he should come in contact with the *vile earth* during the performance of the ceremonies.

‡ *Nai* or barber; the attendants on Rajas and Sirdars at *Bharatpur* are all of this caste. *Nains*, females of the same caste, wait upon the *Rani*.

§ It is the favorite colour of KRISHNA; hence his synonime PITAMBER, the "yellow-clothed" deity.

threads (this colour being esteemed fortunate); that *dúb** grass, an emblem of increase, is put on it; and that gold coins, betelnut, rupees, *haldi* or yellow curry-powder, and yellow rice are placed within the folds of the paper.

The *lagan-patri* is intrusted to the keeping of the *Raní* mother until the day of her death, whilst the *khilat* is sent out by her for the inspection of the Sirdars assembled. When the *Parohit* or his followers, who escorted the *lagan*, have returned to their tents, which are pitched outside the city, it being contrary to etiquette that the bride's party should partake in any way of the bridegroom's hospitality, *Gur* (unrefined sugar) is distributed to the populace. On the third day after this, the *Parohit* returns with presents to the bride.

From the receipt of the *lagan*, the marriage is considered to begin. Marriage songs *(Barna and Barní)* are sung in the houses of the bride and bridegroom, and presents are distributed to the women who sing; these are for the most part females of the same stock *(Got)* as the bridegroom. The subjects selected by them, and the language in which they are illustrated, are alike coarse and ludicrous, resembling perhaps the "sales et convicia" sung by the Roman boys at marriages, or the rude jokes and indecencies which pervade the songs of our older poets.

The Raja's mother sits in the midst of the singers, listening to the songs, and frequently joins in the chorus herself. The singers are rewarded for their labours, and their songs are always in proportion to the reward. There is a common saying, taken from this circumstance, which has passed into a proverb, "*Jysa tera kourí wysa merí gít*," or the goodness of our song will depend upon the number of rupees bestowed on us.

The marriage songs having been instituted, and the body of the bridegroom anointed with jasmine oil, which is applied with *dúb**

* For an account of the sacred *durva* or *dúb* grass, see Asiatic Researches, vol. iv. Observations on select Indian Plants, by Sir W. JONES. The following text is there quoted: " May *Durva*, which rose from the waters of life, which has a hundred roots and a hundred stems, efface a hundred of my sins *and prolong my existence* on earth for a hundred years." Mr. HENRY COLEBROOKE quotes another text in praise of *Durva*, in his learned Essays, and Colonel TODD† mentions that the *Rajpúts* are fond of comparing themselves to this valuable grass, which thrives in almost every soil, and propagates itself for ages and ages. The comparison is not confined to *Rajpúts* alone, it is current throughout upper India.

† I quote from memory, not having Colonel TODD's valuable work by me, the 1*st volume* of which I perused (with less attention than it deserved), two years ago, in Calcutta, the 2*nd volume* I have not yet seen.

grass to his feet, arms, and shoulders, the worship of the potter's wheel (*Chakr-puja*) is then performed by the *Mají* and female relatives of the Raja. This consists in visiting the shop of the family potter, and in offering up sweetmeats, betelnuts, and rupees on his wheel. The praises of this instrument and the article produced by it are chaunted by the women, and the ceremony concludes by a demand on the part of the potter* for a present; upon which there ensues a mock dispute between him, the *Ránís*, and the women, the potter demanding exactly twice the sum to which he is entitled, and the females as stoutly refusing to comply with his demand. The dispute is generally ended by a compromise between the belligerent parties, and the female disputants return to the *mehal.*

Two days prior to the marriage, the women of the *mehal* repair to a tank within the interior of the palace, and having with their hands dug up the wet mud on its banks, bring it on their heads into the inner apartments, where they proceed to construct a miniature store-house or granary for the bridegroom. The meaning of which is obviously this, that it becomes the bridegroom to lay up ample store of provisions for his future wife and family, whilst it is no less incumbent on them (his relatives) to assist him in so doing.

After the worship of the potter's wheel the Raja and the whole of his Sirdars repair in state to the shrine of *Sítlá*, the goddess of the small-pox. Propitiatory prayers and gifts are offered up to this dreaded personage, and various articles of food and incense placed before her. So general, I may add, is the worship of this goddess† throughout these parts, that every village has an altar consecrated to her, which consists generally of a mere heap of stones loosely piled up, with one slab placed perpendicularly, on which a rude image of the goddess is engraved.

The appearance of this goddess is said to be similar to that of an old and wrinkled woman, and, for this reason, the Hindús consider it

* Two reasons are assigned for the worship of the wheel; 1st, that it is the weapon of Vishnu. 2ndly, Its great utility to the married couple, as furnishing them with utensils of every description.

† She is said to ride on a donkey and to have a potter as a groom, and for this reason potters are entitled to the food offered up at her shrine, should it be *Sukri*, or food cooked in a *chulha*, but if *Nikri* or sweetmeats (which by some convenient text‡ are held to be lawful to all Hindús, though cooked by strangers), the Brahmans take good care to secure them.

‡ Provided they are inhabitants of the *Mudh Des*, or country between the *Himálaya* and *Vindhya* ranges.

proper that persons seized with small-pox should be attended by old women alone.

Another still more extraordinary act of devotion is then performed, the worship of the *Gohra* or place in which the filth of the palace is deposited. The worship consists in sprinkling water, perfumes, and sweetmeats on the mass; and it is said to be indicative of the wish on the part of the worshipper, that his progeny may increase and multiply even as the heap of rubbish before him. In like manner, the Hindús are accustomed to throw their sucking teeth on a dunghill, uttering at the time a prayer that their new teeth may quickly appear, and increase even as the dunghill has increased. Strange as this worship may appear to us, we should not forget that it may be defended by classical precedents. If the Romans adored their "Cloacina," surely a less civilized people may be excused for worshipping the *Gohra*.

Upon the termination of these several acts of devotion (ritè peremptis), there remains the ceremony of the *Bhát* to be performed, which is the presentation by the brothers and other male relatives (of the Raníś), of marriage clothes, and presents to the Raja. The presents consist of elephants, horses, camels, clothes for the Raja and Ranís* and *ashrafees*; and are given first to the *Parohits*, then to the Ranís and female attendants, and lastly to the Raja. In return for these presents the donors receive *rice* from the Raja. Hence the name of the ceremony.

When the Raja's mother has put on the marriage† dress thus presented to her, and the circumstance has been communicated to friends and people assembled, the marriage is considered to have commenced, and the liveliest marks of rejoicing are exhibited.

The day before that on which the "*barát*" or marriage cavalcade starts for the place at which the wedding is to be solemnized, the deputations sent by foreign states in honour of the marriage are feasted by the Raja; after the entertainment is over the whole of the Raja's relatives stand up, and whilst the Prince himself remains seated on the *guddee* throw rupees, &c. into a flat iron dish. The women singing the following words:

"*Túni khayo pet‡ pusár yún to lejaega múnh már,*" or you have

* His mother, grand-mother, &c. not his future wife.

† The act of putting on the dress thus presented is called "*bhát paharana,*" a curious idiom enough.

‡ This is an allusion to the *Péthya*, or allowance of food given by the state to the relatives of the Raja. A *Péthya* is literally a bellyful, but varies in quantity and quality according to the pleasure of the granter and rank of the grantee. The

filled your bellies famously. In the same way shall it be taken from you (even) by blows (i. e. should you refuse).

The time having at length arrived at which the marriage procession is to set out, the attendants proceed to array the bridegroom in his marriage garments, which, as will be seen from the following list, are sufficiently numerous.

On his feet he has shoes of embroidered velvet. His *paíjamas* or loose trowsers are composed of *kímkhab,* and under these he has a *dhotí* of yellow silk.

As an under vest or garment he has a *jámá* of cotton cloth, trimmed with silver lace, and dyed of a yellowish red colour *(kesáría).* Over this *jámá* he has an embroidered vest, studded with pearls, (*jerríka jámá,*) and over this again a girdle ornamented in the same way. The *panarth,* a sort of long handkerchief, is tied to his girdle, and thrown over his shoulder, to enable him to keep the dust from his eyes, or wipe it off should any find access thereto. On his head he has the *mor**, or marriage chaplet, which is richly ornamented with pearls and gold embroidery, and is supposed to resemble the helmet of KANHYA, with its plume of peacock's feathers.

His eyelids are stained with *kajul* or lamp-black, his feet and hands with *mehndí*†, and on his feet, hands, arms, and neck, he wears a

*Pethya* of a *Rani,* for instance (see Appendix, B.) comprises all sorts of grain, spices, sauces, &c. and that *sine qua non* of Indian life, *shirní* or sweetmeats. The fondness of all classes, high and low, men, women, and children, for these said sweetmeats is to *us* quite marvellous. I have been assured, that some Brahmans will eat a 100 balls of *laddu* (sugar, ghee, and pounded gram) at a sitting ! ! There is a curious character of an " eating Brahman," a " grand gourmand," in the Hindú Theatre."

* It has a curious sort of veil in front, formed of gold threads, hanging loosely from the head to the breast, which is intended to protect the wearer from the "*evil eye.*" A belief in demonology and witchcraft prevails throughout Hindústan. As a curious instance of " public opinion" among the Jâts on this subject, I may relate the following anecdote, told me by a very respectable native of *Bharatpur.* In 1815-16, the *Bharatpur* Raja, RANDHIR SINGH, had an interview with Lord Hastings at *Futtehpur Sikri,* and was received by that distinguished nobleman with his usual kindness and affability. The Raja was highly pleased with the interview, but happening in the course of the next year to lose his eyesight, by an attack of *ophthalmia,* some of the people about him, who from the first had endeavoured to dissuade him from meeting the Governor General, gave out that his blindness was the effect of " witchcraft " practised on him by Lord H. during the interview, and this tale was generally believed throughout the *Bharatpur* Raj ! !

† Every one has witnessed the beautiful vermilion dye which the natives extract from this plant. It is considered as essential an ornament by Hindú and

variety of jewels, both such as are peculiar to men, as also some which are ordinarily worn only by women. Thus, besides bracelets on his wrists, he wears the *ponchí*, a sort of bangle usually worn only by females. On his neck too, in addition to the common necklace which all Hindús wear (*kanthí*), he has the *hansli*, a kind of collar made of gold or silver, and the shape of which is that of a horse shoe, thus ℧. He has also rings on his little and fore fingers.

Thus attired, the bridegroom proceeds to his mother's apartment, where he has one more ceremony to go through prior to starting: after the usual obeisances, the Raja applies his mouth to his mother's breast, and affects to imbibe some of the milk contained (or supposed to be contained) therein. This is of course a mere form, but it is never omitted by any caste of Hindús, and is obviously meant to remind them of the period when they derived strength and nourishment from their mother's breast alone, and of the duty imposed on them of protecting the parent who cherished them in the days of helplessness.

This sentiment is simply and beautifully expressed in one of Sádi's odes, of which I presume to offer the following version. (See Appendix, C.)

Having received his mother's benediction, the bridegroom leaves the inner apartments, and joins the marriage procession, which is marshalled outside the *mehal*. He is then lifted into a palankeen or *howdah*, as the case may be, or rather as the Brahmans may have directed. The chief thing at issue is the *direction* in which he is to proceed, particular kinds of conveyances being considered fortunate to persons travelling in particular directions: thus, should a person be journeying towards the east, he should proceed on an elephant; if to the south, in a *rath;* to the west, on a horse; to the north, in a *pálkí*. These directions are of course seldom observed by persons of inferior condition; indeed, they are manifestly intended only for

indeed by all Asiatic women as rouge was (I will not venture to say *is*) by our own fair country women. There is this distinction however to be observed in the two otherwise similar cases, no Hindú would think it ungallant to inform his mistress that she was in the habit of "rouging." The custom is prettily alluded to in the "Hindû Theatre," *Vikrama* and *Urvasi*, Act 4, Parura Vas thus speaks: "How shall I learn, if she hath passed this way: the pleasing soil, softened by showers, perchance may have retained the delicate impression of her feet, and show some vestige of *their ruby tincture.*" The subject has been somewhat differently handled by the wits and poets of Europe from the days of Martial down to those of Brebeuf, who is said to have produced no less than 150 conceits on this topic. Some specimens are given by Bland in his "Illustrations to the Greek Anthology."

people of rank and wealth. The *mohrarat*, however, is never violated even by the poorest Hindú, and judging from my experience at *Bharatpur*, I would say their faith in its efficacy is as firm as ever.

On passing through the city, the Raja stops at the "*Behari ji mandir*," the temple of the *playful* god KRISHNA, and makes his obeisances to the *Mehant* or high-priest of the establishment.

There is a tradition still current at *Bharatpur* of the "sable god*" being the *killedar*† of the fort (though not properly within the land of *Bruj*), and for this reason, both he and his ministering priests are entitled to greater honors than are rendered to the other forms of the deity. On entering the *mandir* the Raja seats himself on the ground near the *Mehant*, who does not rise from his *gaddi* or cushion. The Raja humbly‡ invokes the blessing of the holy man, which is accordingly given, the *Mehant* throughout the interview maintaining the tone and manner of a superior, whilst the Raja acts the part of the suppliant. The same forms are observed when the priest visits the Prince in full *darbár*. The Raja rises to meet the saint as he enters the hall of audience, and taking him by the hand, seats him on the *masnad*, himself sitting on the ground beside him. Some idea may be formed from this circumstance of the important part which these *Mehants* play in Hindú states. The high esteem in which they are held by all classes of Hindús, from the Raja down to the "unwashed artizan," necessarily gives them the greatest influence in state affairs, should they be of an intriguing turn of mind, and especially when they contrive to become the *Guru* or spiritual adviser of the Raja. The notorious SRI' JI of *Jeypur*, the *Guru*, and as the Jâts affirm evil adviser of DURJAN SAUL, whom he instigated to his hopeless resistance to our arms, may be taken as a good specimen of an unprincipled intriguing *Mehant*; nor is *Bharatpur* without a similar character, as is well known to the supreme authorities. In general, however, the *Mehants* are said to be quiet, well disposed personages, and I believe that a political *Mehant* subjects himself to as much odium among the Hindús as a political priest does with us. As all the *mandirs*§ have

* The favorite epithet applied to KRISHNA SYAMARE.

† During the assault in 1804-5, our Sipahís protested that they saw the god distinctly ! "dressed in yellow garments, and armed with his peculiar weapons the bow, mace, conch, and pipe !"

‡ Previously to sitting, he performs the *dandavat*, a salutation which consists in raising *both hands joined* to the head, which is, at the same time, slightly bowed.

§ The two principal temples at *Bharatpur* are those of BEHARI JI and LACHMAN JI, the former belonging to the *Nemáwat*, the latter to the *Rámáwat* sect of *Byragis*. The *Mehants* of these temples have each a *Chanda* or cess allowed grants of land from the state or a share in the assessments levied upon villages, they are of course more or less dependent on the will of the reigning Prince.

I may mention here, in order to preserve myself from the imputation of having mistaken the ground on which the extraordinary marks of respect above detailed are paid by the *Bharatpur* Rajas, to the *Mehant* of the *Behari Ji Mandir*, that the present Raja, for reasons which have been already mentioned, had not become the *Chela* of any *Gúrú* at the time of his marriage, and that consequently it was not as his *Guru* or spiritual adviser that he reverenced the *Mehant*, but as being the superior of a temple especially dedicated to KRISHNA.

Quitting the temple, the cavalcade proceeds on its way. As it passes through the city, the inhabitants crowd the tops of the houses, anxious to obtain a sight of the precession, and compare it with those of former princes. The streets are illuminated, with *chirághs* fixed upon bambu trelles work; and as the Prince himself advances, the loud cries of "RAM! RAM!" become more and more frequent; uttered as they are by all ranks and ages, from the grey-headed men of sixty down to the child of three or four years old; add to these sounds, the "concordia discors" of the large *shankh* or shell; the blowing of fifes and trumpets, and beating of drums on the part of the *Paltans*, which precede the Raja; the deep bass sounds of the *Nakáras* or kettle-drums borne by the camel *Sowars*; the shrill piercing tones of the bambú pipe; the tinkling of the elephants' and camels' bells; the waving of chouries; "the dancing of the tall spears" on which the national standards* are fixed; the discharge of fire-works and jingalls, and we have a pretty correct enumeration of the attributes of pomp (and melody!) with which a Hindú Prince goes forth to his wedding.

The women of the different villages through which the *Barát* passes advance to meet it, singing the songs of rejoicing usually sung at the *Húli*†. In return for this mark of respect presents are given them, generally about five rupees per each village.

them by the state upon all villages. The number of villages is about 1,200, and the *Chanda* varies according to the *Rakba*, being seldom if ever above two rupees, nor less than four annas. Besides the *Chanda*, they have the "*Changí*" or *tithe in kind*, levied upon all sorts of grain when exported for sale in the *bazars*, and a pious or superstitious Prince occasionally makes them a grant of a village, i. e. of the government share of the produce, which is collected by the *Mehant* instead of by the *Sirkar*.

* A yellow flag, with the figure of the monkey-general HANUMAN rampant in the centre.

† *Phagua*, so called from the month *Phagun*.

The procession moves at a slow and measured pace: immediately in front of the bridegroom's elephant are stationed a number of water-carriers, bearing skins of water, which they occasionally pour on the ground before him; not with the intention of laying the dust, for that would be considered absurd, but to convey to all beholders the notion that the presence of the bridegroom is as grateful to his mistress and all created things as water is to the parched-up earth.

When the *barát* has arrived to within a mile or two of the town at which the wedding is to take place, it is met by the nearest male relative of the young lady, who comes out thus far to honour the bridegroom, and to conduct him to his tents. This is called the *Peshwaí* or *Istakbal*, and is considered an important part of native etiquette. It obtains I believe throughout Asia, certainly in all Muhammedan countries.

The whole of the bridegroom's Sipahís, attendants, and sirdars, constituting a body of about 8000 men, are dressed in marriage garments, as also those of the bride. In fact, no one would be allowed to form part of the procession, or to be present at the marriage feast who was not so attired. This piece of etiquette throws light on a passage in Scripture, Matthew xxii. "And when the king came in to see the guests, he saw there a man which had not on a wedding-garment, and he said unto him, Friend, how comest thou hither, not having a wedding-garment? and he was speechless. Then said the king to the servants, Bind him hand and foot, and take him away and cast him into outer darkness." A similar violation of established rule and etiquette would meet with a similar punishment, I believe, in any native state.

I shall now describe as shortly as possible the ceremonies which are performed after the arrival of the bridegroom. In the first place, a hookah, bhang, tobacco, cardamums, and *sherbet* are sent to him by the "*Samdhí*" or father of the girl, and the "*Samdhí*" himself waits on him. He is received with much respect by the Sirdars of the court, but the bridegroom neither rises from his seat nor returns his salutation. The natives consider the bridegroom to be a sort of Divinity* for the two or three days during which the ceremonies last, and for this reason he neither returns his father-in-law's greeting nor that of any one else. When the two or three days are over, he relapses to his former "earthly" state.

* However low the caste and station of the bridegroom, he is called a "*arhai roz ka Badshah*," or a "King for two and half days," i. e. during the performance of the ceremonies, which last two or three days, according to the resources of the bride's father, who is expected to feast the cavalcade for at least two and generally three days.

In the evening of the first day, the ceremony of the *Toran* takes place, and at midnight that of the *Hom*. Though there is no mention of the *Toran* in Mr. Colebrooke's Essays, nor any allusion to it in the "Hindú Theatre," or law, it is considered by the Jâts, and I am assured, by all Hindús in Upper India, as a very important ceremony, and as such, is never omitted. The *Toran* is a wooden ornament, or rather the figures of certain little birds, carved in wood, and gilded over with gold leaf. These are fixed above the doorway leading into the *Mandap* or marriage pavilion, and the ceremony consists in the bridegroom's striking or touching them with a sheathed sword.

As soon as this feat has been accomplished, a general sprinkling of *Húli* powder and explosion of fire-works takes place. The Sirdars partake of a *zyafat* at the *Samdhí's* house, whilst the bridegroom returns to his tents, it being considered improper that he should be feasted by his father-in-law prior to the performance of the *Hom*.

Though I have made repeated inquiries as to the origin and meaning of the *Toran*, I have not hitherto received any satisfactory explanation of it:—one reason assigned, and it is certainly a plausible one, is that the touching it with the sword is intended to represent the bridegroom's superiority over the bride, and to convey a hint to her and all present, of the treatment she will receive, if refractory. The New Zealanders, if I recollect aright, convey a similar hint to their intended wives, though in a somewhat coarser fashion, by knocking them down with large clubs previously to the marriage; or perhaps, the *Toran* is some allusion to the kind of wedding or rape entitled *Rakhasa*, which took place between Krishna and Ru'khmani', and is one of the forms enumerated by Menu.

The sacred ceremony of the *Hom* or burnt-offering takes place at midnight, and as it is decidedly the most classical and interesting of all the Hindú sacrifices, I shall endeavour to describe it minutely. I shall not attempt to give the *Mantras*, or incantations used on the occasion: first, because on account of my very slight knowledge of Sanscrit I was unable to determine the particular *Mantra* chaunted by the priests; and secondly because the *Mantras* generally used on such occasions have already been given by Mr. Colebrooke in his admirable papers on the religious ceremonies of the Hindús.

The *Hom* was performed under the *Mandap* or marriage pavilion, at the gateway of which the ceremony of the *Toran* had taken place. The pavilion is erected by the bride's father, and is constructed of wooden posts, gaily ornamented and gilded with gold leaf, having niches for the reception of the small earthen lamps which serve to illuminate the compartments into which it is divided. The whole of the pavilion is carefully covered over with long cloth; and from the roof of it numerous lamps of coloured glass or paper (in which the purest *ghee* is burnt) are suspended by long strings; gilded cocoanuts are also to be seen dangling after the same fashion, and the appearance of these and of the many-coloured lamps is at once fantastic and pleasing.

The spot of ground on which the sacrifice is to be performed having been selected by the Brahmans, the *Nains* or female attendants of the bride proceed to decorate it in the prescribed manner: "The figure of the sacred lotus *(nymphæa nelumbo)*, on which, according to Hindú belief, the deity floated amidst the waters of chaos, is drawn upon the ground in the centre of the *chouk* or square. On the figure of the lotus small wooden stools are placed for the bride and bridegroom, their faces being turned to the east.

Immediately opposite to the *chouk* is the *bedí*, or altar on which the *Aghana* or sacrificial fire is lighted. The altar is square, formed of earth, and ought to be one *hat'h* (cubit) in height, but the dimensions vary. In the centre of it is placed the holy fire, which may be formed of the six following woods; viz. the *Pulas (Butea frondosa)*, *Pepul (Ficus religiosa)*, *Chonkra (Prosopis spicigera—Shumaí* in Sanscrit), *Akh (Asclepias gigantea)*, *Kher (Acacia Catechu)*, and *Onga (Achryanthes aspera*.)*

The father of the girl (*samdhí* as he is called), the bridegroom's nearest male relatives, and the Brahmans who are to perform the ceremonies, having seated themselves round the sacrificial fire, the bridegroom enters the pavilion, carried or supported in the arms of a *nai*. The *samdhí* honours him with a respectful salutation *(dandavat)*, and pronounces a short benedictory prayer, expressive of gratitude for the high honour conferred on his daughter. To this prayer no answer is given, nor is any return made to the salutation.

The *samdhí* then brings a carpet for the bridegroom to sit on. This is placed on the right-hand stool, that on the left-hand being reserved for the bride. He also brings water for the bridegroom's feet, and the Brahmans chaunt a *mantra* in praise of water; but as the *mantra* and this particular ceremony are both described in Mr. Colebrooke's third Essay, any further notice of them would be presumption on my part. The holy element, water, which Pindar declares to be the best of things, is honoured with three adorations. The first, or the ablution, is called *snan;* the second, or the pouring the water on the

* See Piddington's Indian Plants. The *Onga* is the *Upa Maya* of Sanscrit.

ground from a vessel in the shape of a boat, *arghá;* and the third is the sipping, or *achimán*. Surely, there is nothing very "absurd or trivial" in these allusions to the three great purposes to which water is applied in India, and throughout the world, viz. ablution, irrigation, and nourishment.

After the adorations of water, the bride enters the pavilion, and being carried to her father, is by him received with extended arms. He then presents her to the bridegroom, places her hand in his: the latter joining his two palms together to receive hers; as is customary throughout Hindústan with persons when a gift is conferred on them. The Brahmans now proceed to chaunt the *sankalp*, or votive prayer, expressive of the solemn vow by which the bride has been dedicated and given away by her father, and thus after one or two other *mantras*, the *kanya-dán*, which precisely answers to our giving away of the bride, is accomplished.

The *Bharatpur* Pandits assert, that the *kanya-dán* irrevocably fixes the marriage, even though the *Hom* or burnt-offering should not take place. This appears to be contrary to the text in MENU, which declares that a marriage is irrevocable after the seven steps have been taken at the *Hom*. Mr. COLEBROOKE also states that the seventh step renders it irrevocable.

The *kanya-dan* is succeeded by the *parkrama* or *pridakshana*, in other words, the circuits round the altar. The clothes of the bridegroom are tied to those of the bride; their hands bound together with *kusa* grass, or a yellow thread: and in this state they have to perform seven circuits round the altar. The *Shastras* indeed prescribe four circuits as the proper number, but the Jâts always make seven.

The number of circuits having been finished, *mantras* are recited and ablutions offered in honour of *Aghana*, (the god of fire,) the purest symbol of the all-pervading principle of life and power, which, as in the Platonic scheme, is supposed to diffuse itself throughout the mass of created things, and to vivify and animate the countless particles of matter.

"Cœlum et terras camposque liquentes
"Spiritus intus alit, totamque infusa per artus
"Mens agitat molem, et magno se corpore miscet."

Well would it have been for Hindúism, and the myriads who profess and have professed it, had all its symbols and objects of adoration been equally pure and innoxious as *Aghana*.

The worship of *Aghana* being completed, and the marriage rendered indissoluble and irrevocable by the seven steps, the attendant priests chaunt the *Sakhochar* or marriage hymn in honour of the affianced parties' ancestors. The priests present on the part of the Raja contented themselves with enumerating the praises and virtues of three of his forefathers. Of these SURAJ MAL, the founder or consolidator of the Jât power, and RANJIT SINGH, the fortunate opponent of LORD LAKE, naturally obtained the largest portion of the eulogium. There is a very spirited ode in *Brij Bhákha* in praise of SURAJ MAL, nor has the martial prowess of RANJIT SINGH been less honoured, but alas! for the credit of poetical prophecy. The Jât bard who celebrates the fame of RANJIT SINGH, after describing with some minuteness and most woful anachronisms the progress of the British power, which he depicts as a raging flame, kindled in the south, and acquiring heat and consistency as it spread through the country of TIPPU and *Mahárásh-tra,* to the imperial city of *Delhi,* proceeds to immortalize the valour of RANJIT SINGH, by whom this raging element of destruction was checked and *extinguished.*

But though the lapse of a few years has proved the vision of the Jât bard (like most other poetic visions), to be vain and empty, it would be ungenerous to deride the feeling which prompted it. The Jâts are and ever have been deeply national; even in these (their) days of weakness and prostration they cling to the memory of former triumphs, nor are the feelings of the man to be envied who would sneer at them for so doing. The sentiment which inspired the glowing numbers of Tyrtæus, which animated and immortalized the "fatal eloquence*" of Demosthenes and Cicero, and which in modern times has called forth the powers of the bards and orators of Europe, cannot and should not be deemed unworthy of sympathy, though expressed by a Jât poet in his own peculiar language.

After the praise of ancestors, the Pandits read a lecture on the marriage duties to the bride and bridegroom, to which they are both expected to testify their assent. Presents are then distributed to the attendant priests, and the bride and bridegroom proceed in one palankeen to the tents of the latter, where the knot which had been tied in their garments is unloosed, and the damsel dismissed with a present of fruits and flowers to her own house.

The next day, and sometimes the day after also, is spent in festivity and rejoicing. The bridegroom, attended by his principal friends and Sirdars, dines with the bride's father. On this occasion also the etiquette observed will remind the reader of a passage in Scripture. The bride-

* "Mortifera facundia." *Juvenal. Sat.* x.

groom is met at the door of the house by his father-in-law, who receives him with every mark of honour, and with his own hands washes his feet. The feet of the other guests are also washed by the bride's relatives. The whole party then proceed into the interior of the pavilion, beneath which they seat themselves in their prescribed order, and the repast, consisting of various kinds of sweetmeats, is served up on platters of the leaves of the mango-tree. These with pure water and clarified butter constitute the whole of the feast.

As I particularly wished to be present at a Hindú feast, I made a point of attending on this occasion, having first of all ascertained that by so doing I should not in any way hurt the feelings or prejudices of the parties. The *ziáfat* in fact consisted merely of sweetmeats, and these as before stated are eaten by all classes without prejudice or observance of the forms which attend a regular meat, such as purifying the ground with cow-dung, constructing a *chulha,* drawing the lines around it, and eating food cooked by your own hands, or by a Brahman. We were seated near the Raja, and had our platters of mango-leaves filled with sweetmeats, as had the other guests. The persons in our immediate vicinity, whether restrained by our presence, or from etiquette, did not appear to do much honour to the viands. I observed however that those seated further off were either more hungry or less ceremonious, and I was much amused by the prowess of one of the guests, "a good portly man i'faith and a corpulent one of a cheerful look, a pleasing eye, and a noble carriage," whose platter appeared, like the cask of the Danaidæ, to empty as fast as it was filled. On the third day largesse is distributed by the bridegroom's father to the *Bháts* or bards who assemble in large numbers on such occasions. The mode of distribution is as follows :—For some days previous to the celebration of the marriage, these votaries of the "Gentile art" flock from all quarters to the place at which the wedding is to be solemnized. To every man, woman, and child, so assembling, a donation is made, generally to the amount of one rupee per head, whilst smaller sums of from eight to four annas are also given for the wretched *tattús* or bullocks on which the owners may have come, and frequently to any animals, such as monkeys, parrots, or dogs which they may bring with them :—for it would be considered a stigma on the bridegroom's hospitality, should any creature attend his marriage with the hope of largesse, and be sent away empty-handed. This custom of promiscuous and ill-judging expenditure on the occasion of marriage obtains amongst all classes of Hindús, from the Raja, to the *chumar* or outcast. It even masters the well known avarice of the *Banya* or merchant, who will squander in marriage rejoicings, sums which it has cost him many a year of griping and patient avarice to accumulate, and which perhaps could not be extracted from him by the severest tortures.

The multitude of *Bháts*, and their attendant bipeds and quadrupeds, is collected together in some secure and commodious place, where there is but one egress. The distribution of money then commences, and as each individual receives his allotted gift, he is directed to depart by the single entry, which is guarded by sipahís, and closed as each *Bhát* departs with his reward. By this system, confusion is prevented, nor is it possible for individuals to claim and receive their quota more than once, as they would otherwise undoubtedly do.

Liberal presents are also made to the "*Negí-Jogí,*" or persons who have contributed by their handicraft towards the preparation of the marriage, such as potters, sweetmeat-makers, and other professors of the useful arts. Little distinction is made on such occasions between the *Bhát,* whose vocation is (or ought to be) of an intellectual nature, and the artizan whose labours are purely manual. If any distinction is drawn, it is to the prejudice of the poet, and he obtains a less reward than the maker of comfits. The reader may perhaps consider this an unfair valuation of the merits of these two classes, or it may remind him of the ingenious "Maitre de danse" in Gil Blas, who indignantly asks how four double pistoles per month can be considered an extravagant remuneration for *his* labours, when a fourth at least of that sum would be paid for a mere "*Maitre de philosophie**."

The religious and family ceremonies of the marriage having been concluded, the bride was escorted with much pomp to the house of the bridegroom, at *Bharatpur*. On arriving at the fort, she proceeds to the *deohrí* or palace appointed for her reception ; at the threshold of this building she waits for the arrival of the bridegroom, who follows her at a short distance, and as soon as he has joined her, a knot is again tied in their garments, and they proceed together into the interior of the *deohrí.*

At the entrance into the first court, the couple is met by the daughter of the bridegroom's *parohit,* who stands as centinel of the sanctorium, and refuses to admit them until her usual free has been granted : on obtaining this she allows them to proceed.

* "Combien prenez-vous par mois ? quatre double-pistoles, reprit-il ; c'est le prix courant, et je ne donne que deux leçons par semaine. Quatre doublons par mois ! m'ecriai-je, c'est beaucoup. Comment beaucoup ? repliqua-t-il d'un air etonné ; vous donneriez bien *une pistole par mois à un maitre de philosophie !*"

The household gods, images of whom are placed within the *deohrí*, having been duly reverenced by the bride, she is ushered into the apartments allotted to her, and is shortly after visited by the female relatives of the bridegroom, who claim the privilege of removing her veil and of gazing at her hitherto secluded charms. This practice is known by the name of *múnh-dikhaí*, or the face-shewing, and the females thus honoured by a gaze are expected to make a handsome offering to the bride for the favour conferred on them.

The bride remains for three days and nights at her husband's residence, but the marriage is not consummated on this occasion. Various rites and usages are practised during the three days, but as this paper has already far exceeded the limits to which I originally intended to confine it, I shall content myself with briefly adverting to two of the most singular customs. The one is the untying of the *kankan* or bracelet of *kusa* grass, which previous to the marriage is bound on the right-hand of the bride, and left of the bridegroom.

The bride and bridegroom being seated opposite to each other, proceed to unravel the knots and mazes of their respective *kankans*. Should the husband succeed in undoing the bracelet of the wife before she has untied his, the feat is considered typical of his future superiority in domestic life, and great rejoicings are immediately made by his attendant relations. If, on the other hand, the lady should first unravel the bracelet, her friends celebrate her dexterity, in noisy and triumphant songs of applause.

A curious game of chance also takes place between the newly married couple. A large tub or caldron of water is placed before them, and jewels, gold-mohurs, and rupees are thrown into it. The bride and bridegroom plunge their hands into the basin, and whoever succeeds in extracting the larger quantity of jewels or money from its depth, at one dip, is supposed to win the game. The old English amusement of Snap Dragon was regulated, I believe, on similar principles.

Childish as these practices may appear to us, they are at any rate harmless, nor with reference to the youth of the parties engaging in them, would they appear to merit the censures of the cynic. Who has not engaged in similar triflings, and felt the pleasure which such innocent amusements excite, in the days of youth and joyousness, when the heart is as yet whole, and unscathed by the cares and cankers of time?

On the expiration of her three days residence at the house of her lord and master, the bride returns to her relations for a period of 1, 3, or 5 years, and she is then brought home by the bridegroom to assume the duties of the married state. This second bringing home of the wife is termed *gona* or *gaman*, and is usually the consummation of the marriage; but the *gaman* may be altogether dispensed with by the performance of the *phir-pattah*, or changing the stools of the bride and bridegroom, when the *Hom* is celebrated.

Such then are the rites and usages by which the marriage of a Raja is marked among the Játs. The same rites and usages are observed by the meanest of his Ját subjects, who are equally tenacious as he may be of the ways of their forefathers. Some of the customs above enumerated are of course omitted by parties in inferior circumstances, such as the largesse to *Bháts* and others, the distribution of sweetmeats to the marriage cavalcade, &c.; but this arises entirely from the want of resources, and never from the belief that there is anything absurd or unworthy in the ceremony itself.

The reader who has had the patience to peruse the above remarks, will doubtless have observed, that agreeably to Hindú law and practice, the father of the bride is by no means considered on an equality with the bridegroom, but is obliged to demean himself as an inferior* towards his future son-in-law. To this extraordinary and unnatural custom, and to the feelings of degradation and wounded pride, excited by it, we may attribute the dreadful crime of female infanticide.

I have omitted to mention that the marriage† of widows is permitted and practised among the Játs, and that the rite of *Suttee* is consequently unknown.

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## APPENDIX.

### A.

The ancient name of *Díg* was *Díragh* or *Dírghpura*, and will be found mentioned in the *Skand Purán*, and 4th chapter of the *Bhagavat Mahútama*. After the disappearance of Sri' Krishna, *Brij-Mandal*, the country of *Brij*, became deserted. Brijr Nab, the son of Pridhun and grand-father of Krishna, presented himself one day before Sandil Rishi, the celebrated sage (who had resided in that holy quarter for upwards of a thousand years), and asked him where Kanhya had fled to. The saint replied, he has not fled, he is still in *Brij*, though invisible; perform *tapasya* (religious penance) and he will re-

* He washes the bridegroom's feet as stated above, an unequivocal recognition of inferiority on his part—Sic passim.

† Perhaps the term *marriage* is too strong for this sort of alliance. It is what we call a left-handed marriage, and yet the issue of such marriages is considered in all respects legitimate.

appear to you, fear nothing; BRIJR NAB then asked, But where am I to reside? He answered, In the following places, which will revive and flourish under your auspices, make thou thy Royal abode;—*Govardhan, Dírghpura* or *Díg, Mathura, Mahában, Nandgrám* and *Barsana**."

The above six towns are considered the most distinguished of all the holy *bans* or places of pilgrimage in the circle of *Brij*.

Close to the fort of *Díg*, which is only separated by a wet ditch from the *bhowans* or garden-palaces, are two places greatly distinguished in the *Mathura Mahátama*, or traditionary history of *Mathura*, and the *Brimha Bybart*, or transformations of KRISHNA. One of them is called *Krishna-kund*, or the pool of KRISHNA, and the other *Sámbar*, a corruption of *Swyambara*, the free or self-election of a husband.

At this public place the princes of the country used to assemble on great occasions of marriage. The lady having performed the tour of the circle where they stood, signified her choice by throwing a garland of flowers upon the neck of the Prince she preferred. There are many instances of this practice on record. In the pleasing history of the loves of NÁLA† and DAMYANTI, the poet elegantly describes the *Swyambara* or election of DAMYANTI, whose sagacity enables her to distinguish the *real* from the *false* NÁLAS, and whose affection teaches her to prefer the mortal object of a mutual passion, to the Deities who from envy and malice had assumed the form of her lover.

The latest *Swyambara* perhaps known, occurred at *Kanouj*, and was attended with serious consequences, as the animosity it excited between the father of the princess and her lord laid India open to Muhammedan aggression, and paved the way for European ascendancy; (see Quarterly Oriental Magazine for 1825. The choice of DROUPADI.)

B.

For the edification of the curious in such matters I subjoin the translation of a Hindí paper, shewing the amount and quality of the *pethya* of a *Rani*.

* For the satisfaction of the Sanscrit scholar I subjoin the Sanscrit *shlok:*

गोवर्द्धने दीर्घपुरे मथुरायां महावने ।
नन्दिग्रामे बृहत्सानौ कार्या राज्यस्थितिस्त्वयं । १

† An elegant edition of NA'LA and DAMYANTI, as contained in the *Mahabhárat*, has been given to the public by Professor BOPP.

*Amount of allowances, money, &c. issued from the godowns of the Sirkar to Rani, Sambat* 1885.

| | Rs. | As. | Ps. |
|---|---|---|---|
| *Cash yearly.* | | | |
| Pay for bearers, .......... | 39 | 12 | 0 |
| Ditto for Dewriban or Door-keeper, ............... | 24 | 0 | 0 |
| To Hardeo, maker of sweet-meats, ................. | 57 | 12 | 0 |
| To Munsa, vender of pan (7 pans per diem), ........ | 3 | 8 | 0 |
| For twine and pack-thread, | 0 | 10 | 0 |
| For Sewchoudassi or the 14th Phagun, presents to the Jogis, ............. | 15 | 0 | 0 |
| For Hulí and Daséra, .. | 20 | 0 | 0 |
| For Tij Sáwan, the 3rd day of the month of Sáwan, | 15 | 0 | 0 |
| For medicines, &c......... | 19 | 3 | 3 |
| For dyeing cloths, ........ | 8 | 2 | 0 |
| Attah, 5 mds. 20 seers,.... | 58 | 13 | 0 |
| Dal, 8 mds. 10 seers, .... | 8 | 4 | 0 |
| Ghee, 5 mds. 2 seers, .... | 50 | 8 | 0 |
| Salt, 2 mds. 11 seers, .... | 2 | 10 | 9 |
| Rice, 1 md. 5 seers, ...... | 2 | 8 | 6 |
| Sugar, 37 seers, ........ | 7 | 6 | 3 |
| Gur, 2 mds. 5 seers, .... | 5 | 5 | 0 |
| Oil, 2 mds. 20 seers, .... | 10 | 0 | 0 |
| Barley, 9 mds. .......... | 6 | 0 | 0 |
| Dal of gram, 20 seers, .... | 0 | 8 | 0 |
| Sínkh, 20 seers, (grass, of which brooms are made), | 1 | 0 | 0 |
| Spices, such as haldi, dhania, &c. .... ......... | 3 | 2 | 0 |
| *Cloths.* | | | |
| Wrappers and quilts, .. .. | 5 | 8 | 0 |
| 2 pieces printed cloth, (chintz of Jeypur,) .. .. | 6 | 0 | 0 |
| 1 ditto ditto, (of Agra,) .. | 4 | 8 | 0 |
| 1 piece Sallie cloth, ...... | 2 | 0 | 0 |
| 1 piece Jhoonah ditto, .... | 2 | 0 | 0 |
| ½ piece Mashru of Agra, (silk and cotton mixed,) | 1 | 6 | 0 |
| 7 yards Gazi cloth, .... | 0 | 8 | 0 |
| 7 ditto Garrah cloth (coarser cloth), ............ | 1 | 8 | 0 |
| 3 hath Deriace cloth,...... | 0 | 3 | 0 |
| 5½ pieces Metah cloth of Shajahanpur for Lahenga or petticoat, .. .......... | 13 | 12 | 0 |
| 4 ditto printed cloths (green chintz), ............. | 8 | 0 | 0 |
| 2 ditto ditto (ditto yellow), | 2 | 0 | 0 |
| 51 yards black printed cloth, | 6 | 0 | 0 |
| 2 ditto red cloth, ........ | 0 | 8 | 0 |
| 2 Dhotis, .............. | 2 | 0 | 0 |
| 1 piece Chinese chintz, 12 yards (probably English), | 24 | 0 | 0 |
| 9½ yards Metah cloth for dopatta, ............... | 2 | 0 | 0 |
| 4½ ditto Mamudi, ditto,.... | 1 | 8 | 0 |
| 2 pieces ditto for Duhar,.. | 12 | 0 | 0 |
| 1½ ditto Garrah cloth of Biana, ................. | 3 | 0 | 0 |
| 6½ ditto Metah cloth, in honour of "Sáwan Tij," (3rd day of Sáwan,).... | 18 | 12 | 0 |
| 1 ditto Dhoti for Sanjáp, | 2 | 8 | 0 |
| 4 pair shoes, ........... | 2 | 8 | 0 |
| Colours for cold weather, .. | 8 | 2 | 0 |
| Total Rupees, | 489 | 3 | 9 |

## C.

The ode alluded to will be found in the 6th Book of the Gulistán, Story 6th. It begins thus, چه خوش گفت ذالی بفرزند خویش and the translation which has at least the merit of fidelity is as follows:

> "Well spoke the Matron! who beheld her son
> "Prostrate the Pard—with elephantine chest—
> "Wouldst thou! but think upon thy childhood, when
> "Helpless, thou us'd to cling upon my breast—
> "Thou wouldst not, now a warrior bold—
> "Oppress me—me thy Mother old!"

II.—*Report on the Geology of Hyderabad. By* H. H. Voysey, *Esq. Surgeon and Geologist to the Great Trigonometrical Survey of India,* 1819*.

The country in which Colonel LAMBTON carried on his Trigonometrical Survey, during the months of January, February, and March, 1819, lies between *Hyderabad* and the *Godavery.* The most northern station being the hill of *Shivalingapah,* near the *Godavery.* The most eastern, *Chittial* near *Maidak;* and the most western, *Oudgir.*

The country between these points was traversed in many directions, and the nature of the rocks, minerals and soils described; and although in many instances it was not possible to ascertain the extent of the ranges by tracing them through the jungle, yet the appearance of an identical or nearly similar rock taking the same direction has been thought a sufficient proof of the continuity of the formation.

* The papers of Doctor VOYSEY have long been anxiously inquired for by his friends in India. After his death it was known that his numerous manuscripts and journals had come into the possession of the Asiatic Society, and had been placed in the hands of some of the Members of the Physical Committee, in order to be digested and arranged for publication. This arduous but pleasing task had in a great measure been accomplished by the successive labours of Mr. WILSON, and Captain FRANKLIN but principally of the former. The relatives of Doctor VOYSEY in England, anxious only for the fame of one whose memory was so dear to them, had freely and feelingly consented to such use being made of his papers; when a temporary check was experienced from an unexpected quarter. Mr. HAVELL, a professional artist, had it seems given Dr. VOYSEY a few hints in sketching; and had made some illustrative drawings (though but one such was found among the papers) which he considered of sufficient value to be made the subject of a formal claim. " Dr. VOYSEY's valuable collection," says his letter, " his writings, and my drawings have been seized upon *by some calling themselves the Asiatic Society;* they are about to publish a selection from his writings, without consulting his friends, or making them any *compensation!*" It might have been presumed, that a man who had lived in India would have known that scientific works were not very likely to pay the expence of publication, much less to realize profit, however the more favored productions of artists might succeed! From this and other causes however the digest of his journals has been hitherto prevented from seeing the light, and they were less likely to do so in the present depressed state of the Society's pecuniary means. We are therefore happy in the permission granted us to publish them in the pages of this journal, either separately as has been done with BUCHANAN's Statistics, or incorporated chapter by chapter with the monthly numbers of the work. As a commencement, we have selected the reports submitted to the MARQUESS OF HASTINGS, by Dr. VOYSEY himself, as Geologist to the Trigonometrical Survey, in 1819 and 1820. These in fact form the best digest of his proceedings for those two years, and they will serve to introduce the reader to a preliminary knowledge of the Geology of the Hyderabad provinces, while their separation will not interfere with the text of the journal itself.—ED.

Any person who has travelled in India will be aware of the difficulties attending a deviation from the main road, especially in an unfriendly country; this circumstance, with the necessity of attending to those professional duties which were incompatible with any protracted absence from the camp, will, it is hoped, be a sufficient apology for any apparent deficiency in my attempt to take a general survey of the mineralogical character of the country in which my partial observations have been made.

It may also be proper to state in this place, that the scarcity of all kinds of meteorological and other apparatus prevented me from making any other than very general observations; and although provided with one of Gay Lussac's *Syphon* Barometers, yet the scale had been so imperfectly graduated in Calcutta, as to allow me to place but little reliance on the observations and calculations of heights obtained from it. This latter defect is of minor importance, since the heights of all the trigonometrical stations will be determined by Colonel Lambton himself in the progress of the survey*.

The geology of the country between the *Kistnah* and *Godavery* admits of a very simple division, being distinguished from most other countries of a similar extent, by the existence of only two formations, differing very widely in their characters; viz. granite and Werner's flœtz trap, both of which give a striking and separate character to the scenery, cultivation, and vegetable productions. It is proposed, therefore, in this sketch, to bring together in a general view the principal characteristics of each division; to contrast them; and finally to enumerate the minerals collected, giving their description and analysis as far as it could be performed.

After quitting the limestone on the banks of the *Kistnah* [to be hereafter mentioned], granite alone is the basis of the country, even to the *Godavery*.

Certain characteristics belong to it throughout, which sufficiently mark its identity and contemporaneous formation. They are,

1st. The great irregularity of extent and direction of the ranges.

2nd. The narrow but lengthened veins or dykes of trap with which it is intersected, all running nearly in the same direction, and the masses of micaceous and sienitic granite with which it is intermixed.

3rd. The predominance of the red colour, arising from the red felspar, which is frequently in large crystals, giving the granite a porphyritic appearance.

* Colonel Lambton computes the height of *Hyderabad*, above the level of the sea, to be 1800 feet.

4th. The concentric lamellar and distinct concrete structure; the great facility of decomposition; the rounded appearance of the decomposed masses, logging stones, and tors.

5th. The numerous lakes or tanks spread all over the country, some of which are of very large dimensions.

1st. The granite is rarely seen in ranges until a near approach to *Hyderabad;* when it first appears after crossing the *Kistnah,* it is seen principally in rounded blocks, scattered without order, and in flat masses of large dimensions, very little elevated above the surface. These however increase in size and height as we proceed to the north westward, where in the waving plain, in which the two remarkable hills of *Nelgondah* are situated, numerous rounded isolated hills are seen spread over it in every direction, unconnected even by their bases. The hill of *Nelgondah* presents the first approach to the continued range; its summit is about 1000 feet above the plain, declining gradually to the north-west until it reaches that level. At *Mulkapúr* more regular granitic ranges in the same direction appear, and are continued to *Hyderabad,* not without frequent interruptions, and the interposition of large isolated mountains of solid granite. Here, however, it must be observed, the granite assumes a new character, derived from the numerous logging stones and tors of the most grotesque figures and extraordinary position. The origin of these logging stones may be traced to the tors, which are masses of tabular granite, generally not more than two or three in number, the interstices of which, admitting the rain, subject the granite to a more rapid decomposition in those than in other parts of the masses, and ultimately give them the rounded forms and tottering bases* observed.

It may be asked, wherefore other rocks, such as greenstone and basalt, do not assume similar appearances in decomposition? It is probable that a sufficiently satisfactory reason may be assigned in the different directions of their interstices, which in the granite are horizontal, whilst in the above-named rocks they are vertical.

The last place to north-west where these logging stones were observed is *Bíchkúnda,* in latitude nearly parallel to *Oudgir,* and not far distant from the place where the granite becomes every where covered by the trap.

Three formations of quartz rock have been observed, viz. at *Secanderabad, Jogipet,* and *Pitlam,* the base of the whole being granite. That

* See description of the logging stones in Cornwall, in the Transactions of the Geological Society.

of *Jogipet* is the most extensive, being three or four miles in length, above fifty feet high in its highest part, and three or four hundred yards in breadth. It is crystallized in *rhombs*. Some of the angles are very perfect.—2nd. The number of trap veins which have been particularly noticed amount to seven, four of which are in the neighbourhood of *Hyderabad*, one at *Koulas*, and two in the neighbourhood of *Maidak*. The vein which passes near *Golcondah* has been traced to the eastward nearly six miles, and is said to be continued nineteen miles farther. They all resemble each other in composition, in their direction (nearly east and west), and in other particulars, of which a more detailed description will be offered in a paper devoted particularly to the description of the country around *Hyderabad*.—3rd. From *Mulkapúr* to the *Godavery* the granite is most usually red and porphyritic. The red granite is much more subject to decomposition than the white, from the abundance of iron contained in the felspar. The granite of *Nelgondah* is the whitest, particularly that from the summit of the mountain. The mixture of micaceous and sienitic granite, in veins and in rounded lumps, has been observed at *Tuperty*, at *Nelgondah*, at *Secanderabad*, and in the bed of the *Manjera* near *Suldapuram*.—4th. It will be easily seen from the previous description of the ranges, that numerous small valleys and plains must exist with such an arrangement of mountains. These valleys covered with water during the rainy season are artificially divided by large, and in some instances, by stupendous banks or mounds of stones or earth, leaving outlets for the passage of the water collected in the upper part, to fertilize the lower grounds during the dry season. The ground by these means is enabled to produce two crops of rice in the year, with sometimes an intermediate one of the holcus saccharatus *(jowar)*; but this depends on a peculiarity of the soil, to be adverted to in the description of the trap country. On the borders of the lakes or tanks thus formed are seen the date and palmyra trees in great profusion, whilst the water itself is covered with aquatic birds and waders. Within about 20 miles radius from the station of *Suldapúr*, on a misty morning, thirty-three of these lakes were counted, most of them of considerable dimensions. On the granite hills, in the interstices of the rocks and on the barren soil, the result of their decomposition, are only seen dwarfish plants of the custard-apple, cassia auriculata, butea frondosa, and a few others. Large trees are only seen in the valleys, where the soil is intermixed with richer materials, and water is more abundant.

These are the principal characteristics of the granite country as seen at *Hyderabad, Maidak, Banchapilly, Koulas*, &c.

The next division of the country consisting of basaltic trap is interesting from many causes: they are, viz.

1st. Its appearance on the upper half or summit only of some of the granite hills.

2nd. Its transition from a highly crystalline compound of felspar and hornblende (the greenstone of WERNER) to coarse and fine basalt, to wacken, and to iron clay, the passage being sometimes so gradual from one to the other, as to give the intermediate mineral an indeterminate character.

3rd. The direction and peculiar form of its ranges, the waving form of the land in some instances, and, in others, its flatness and conical peaks.

4th. The intermixture of carbonate of lime with the wacken, the basalt, and even with some of the granite in the neighbourhood of the trap.

5th. The black cotton soil, arising generally from the decomposition of the basaltic trap, forming the banks of the rivers, and covering their neighbouring plains. It is also found at a considerable distance from that rock, and on heights so elevated as to preclude this cause in attempting to explain its origin.

1st. At *Tandmanur, Suldapuram, Madcondah, Koulas, Baktapúr,* and *Adampúr,* the granite forms the basis of the hill, and sometimes its lower half, and is covered by the trap, which in some instances has the appearance of having flowed partly down the hill when in a fluid state. In the immediate neighbourhood are hills, whose summits although much lower, shew no trace of the trap rock having once covered them. In one instance, the hill of *Koulas,* a vein of trap crosses one of these hills, but its appearance indicates rather an ejection from below than a deposit from above: it affords at the same time a good example of the identity of the greenstone, the basalt, and the wacken.

2nd. The places the most remarkable for the changes which the basalt undergoes are *Buktapúr,* where it passes into wacken, *Koulas,* as above-mentioned, *Beder,* where the iron clay passes into both. The basalt is not always the lowest, as its greater specific gravity would lead one to presuppose, but is frequently above wacken. It is, however, always found beneath the iron clay. As a general description of the basalt, it may be observed, that it decomposes into round masses, having an exterior crust of a few lines in breadth, of a yellow or lighter colour than the interior. In the ravines, and where exposed to any depth, it resembles very much the drawings in vol. viii. page 171, *Thompson's Annals,* of the Rowley Rag Basalt. Basaltic columns were observable in two places only, at *Múngánal* and at *Oudgir;* at the latter place, the largest exceeded a metre in diameter, was about three feet in height, eight-sided, and the interstices between the columns were filled with green earth and globular wacken.

3rd. The direction of these ranges is to the north-west, although the interruptions are numerous, and it frequently happens that a range appears to cross at right angles to the main one. Their form is generally much flattened, with two or three conical peaks; sometimes the continuation of the flat range is interrupted by a valley, which presents the appearances of the embrasure of a fortification, which is repeated several times in an extent of ten or twelve miles. The summits of *Tandmanur, Medcondah, Burgapilli, Monegal,* and *Mungánal* are of waving land, rounded summits, separated by ravines of different depths, which in the rainy season afford a passage for the water into the plains, depositing on the banks of the streams and rivers the black cotton soil, which is the result of the decomposition of the trap rocks.

4th. At *Bucktapúr,* at *Shivalingapah,* at the *Godavery,* at the *Laendy* river, near *Daiglúr,* and at *Chilliriga,* near the *Mangera,* carbonate of lime is intermixed with the rock, whether sienitic, greenstone, granite, basalt, or wacken.

At *Daiglúr* large rounded masses of a small grained red granite are enveloped in a cement composed of carbonate of lime, red felspar, and quartz in grains: this extends to a few miles above and below the ford. At *Chilliriga* the basalt and wacken, or substance intermediate, is mixed with a greenish limestone which has large vacuities in it, from its decomposition taking place more slowly than the trap with which it is mixed. In the space of a few feet pure basalt is here seen passing into wacken, and the latter into the mixture of limestone, which last ultimately passes into pure limestone.

5th. The black cotton soil is not only found on the banks of all the rivers and streams generally, to the height of about thirty feet, and where it has been deposited by floods, but also in places two or three hundred feet above those rivers. On the road from *Beder* to *Shelapilly,* which lies over a stratum of iron clay, varying from 100 to 150 feet in thickness, four well defined zones of black cotton soil are crossed, running north and south and lying between ridges of iron clay. We encamped at *Shelapilly* on one of these zones, which had nearly a north and south direction, and from a conical elevation, forty feet in height, composed of the same soil, observed the iron clay on each side about half a furlong distant. This soil is rich and peculiarly adapted to the cultivation of dry grains, which denomination is given to various species of panicum, the holcus saccharatus, maize, zea, &c. from its power of retaining moisture, which enables it without artificial irrigation to produce fine crops during the dry season. The plasticity, as found a foot below the surface in the month of March, is such that it could be kneaded into balls with the hand. In some places where the black cotton soil is intermixed with that from the decomposition of the granite, three crops are produced, two of rice and one of dry grain, the latter on the ground from which the first crop of rice has been cut.

This soil is first met with at *Patancherú,* where it is intermixed with the debris of the granite, and has been no doubt deposited there by the floods of the *Manjera,* from which it is distant about ten miles. A corresponding change also takes place in the appearance of the country, which assumes a richer aspect: the natural productions of each soil being there intermixed.

The hills from which this soil proceeds have formerly been cultivated even to their summits. In most places small piles of stones, formerly cleared from the land, and occasionally the remains of a stone boundary, were the only memorials of former cultivation. The poa cynosuroides *(Cusa grass)* grows in the greatest profusion; it is rendered so dry in the months of March and April, that a very slight ignition will cause it to burn with inconceivable rapidity and fury. Our camp was once in considerable danger from this circumstance. The vegetable productions most frequently met with are, the

| | |
|---|---|
| Butea frondosa, | Ficus, three species, |
| Cassia Malabarica, | Tectona grandis, |
| Semecarpus anacardium, | Tamarindus Indica, |
| Averrhoa carambola, | Mangifera Indica, |
| Dalbergia acuminata, | Spondias Mangifera. |

Mimosa, six species, and many others which my botanical knowledge did not enable me to name without the aid of their flowers. All these seem to acquire their greatest perfection in the places where the two above-mentioned soils are intermixed.

It only remains to notice some anomalous appearances in the trap at *Medcondah,* and in the wacken at *Shivalingapáh.*

At the former of these places was observed in numerous detached masses, flint with a very rough external surface, varying from a few inches to a foot and a half in diameter, some of them deeply connected, so that their size may be supposed much greater; also numerous pieces of a siliceous stone containing shells*, the specific gravity of which varies

* Turbo cyclostoma, land-shells.

from 2 to 2·5. The shells do not effervesce in acids, although some of them still preserve their external polish. Internally some of these stones, particularly the lighter, appear to pass into flint, whilst their external surface effervesces in acids.

Not far distant, lumps of a greyish yellow limestone, crystalline, and earthy, the latter containing shells nearly similar to those in the siliceous stone.

At *Shivalingapah* the wacken contains shells which preserve more of their carbonate of lime. Those appearances are the more singular, since the land at *Medcondah* is a continuation of the basaltic trap at an elevation of nearly 2000 feet above the level of the sea, distant from the *Manjera* 14 miles, and 200 feet above the bed of that river.

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## III.—*On the reputed Descendants of Alexander the Great, in the Valley of the Oxus. By Lieut.* Alexander Burnes, *Bombay Army.*

[Read at the Meeting of the Asiatic Society, 29th May, 1833.]

In speaking of the existence of Grecian colonies in the remote regions of Central Asia, said to be descended from Alexander of Macedon, it is necessary to premise, that I am not indulging in speculation, but asserting a lineage of various tribes of people, that is claimed by themselves, and merits therefore our attention. Marco Polo is the first author who mentions the existence of such a people, and informs us that the Meer of *Badakhshán* laid claim to a Grecian origin. The emperor Baber corroborates the testimony, and the historian of his grand-son Akbar, the renowned Abul Fazl, points to the country of the *Siahposh Kafirs,* north of *Pesháwar,* as the seat of these soi-disant Macedonians. Mr. Elphinstone has, I think, successfully refuted this supposition, for the *Kafirs* are a savage and mountainous tribe, without a tradition on the subject.

The great elevation of their country appears to me satisfactorily to account for all their physical peculiarities, nor can I look upon these people as any other than the aborigines of the plains, who fled to their present elevated abode in the wars that followed the introduction of Muhammedanism. *Kafir* means simply an infidel, and is applied by Muhammedans to all who disbelieve in their prophet. Mr. Elphinstone confirms the statement of Marco Polo by telling us, that the chief of *Darwáz,* in the valley of the Oxus, claimed a descent from Alexander, which was admitted by all his neighbours. Such was the extent of information with which I entered the valley of that river, sufficient it will be said to excite the utmost curiosity, and it will be seen that I found ample encouragement in the investigation of such traditions while in the very seats of their existence.

If it was believed that the chiefs of *Badakhshán* and *Darwáz* alone laid claim to these hereditary honors, what was my surprise to find that there were six other personages established in them, at least to the satisfaction of the people. The chiefs that extend eastward of *Darwáz,* and occupy the provinces of *Kúlab-shagnán* and *Wákhan,* north of the Oxus, assert the same descent. The MEER or chief of *Badakhshán* receives in modern times the honors mentioned by the Venetian traveller. He has the title of *Sháh* and *Málik,* or king, and his children, that of *Sháhzádá* or Prince; but this ancient house has been subverted within these twelve years by the MEER of *Kúndúz,* and *Badakhshán* is now held by a *Túrk* family. To the eastward of *Badakhshán,* and extending to *Kashmír,* lie the hill states of *Chitral, Gilgit,* and *Iskardo,* where the claims to a Grecian descent are likewise conceded to each of the princes. The first of these has the title of *Shah Kator.* The present ruler is of small stature, and possesses as great a celebrity in these countries for his long beard as the *Shah* of Persia. The chief of *Iskardo* occupies a singular fortress on the Indus and N. E. of *Kashmír,* which he has the hardihood to assert was constructed in the days of Alexander himself! This country borders on little Thibet or *Baltí.* Nor is this the ultimate limit of the tradition; for the soldiers of the *Túnganí* tribe, who are sent from the western provinces of China, and garrison *Yárkand* and the neighbouring cities, also claim a Grecian origin. They however seek with greater modesty a descent from the soldiers of ALEXANDER's army, and not from the conqueror himself.

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Such is a correct list of the reputed descendants of ALEXANDER THE GREAT, and it is in some degree confirmatory of their claim, that the whole of these princes are *Tájiks,* or the aborigines of this country before it was overrun by *Túrkí* or *Tatár* tribes. But how shall we reconcile these accounts with the histories that have travelled down to our times, whence we learn that the son of PHILIP did not even leave an heir to inherit his gigantic conquests, much less a numerous list of colonies that have survived a lapse of more than two thousand years in a distant quarter of Asia? Whether their descent is viewed as true or fabulous, the people themselves acknowledge the hereditary dignity of the princes, and they in their turn claim every royal honor and refuse their children in marriage to other tribes. These *Tájiks,* being now converted to *Islám,* view ALEXANDER as a prophet, and to the distinction which they derive from his warlike achievements, they add the honor of being related to one of the inspired messengers of the Deity. I have had opportunities of conversing with some members of the *Badakhshán* family, but there was nothing in form or feature which favored their Grecian lineage, nor is there any thing in the languages of any of these tribes (of all of which I have specimens), that indicate a connexion with Greece. The people are fair complexioned, and not unlike the Persians of modern times, while there is the most decided contrast between them and the *Túrks* and *Uzbéks*.

We learn from the historians of ALEXANDER's expedition that he warred in the kingdom of *Bactriana*. The city of *Bálkh*, that lies in the vicinity of these territories, is readily fixed upon as that capital of the Greek monarchs. Setting aside every local identity, the modern inhabitants will inform you that the country between *Bálkh* and *Cábul* has the name of "*Bakhtar Zemín*," or the *Bakhtar* country, in which we recognise *Bactria*. This fact renders it by no means impossible, that a Grecian colony had some time or other existed in the country. It may therefore be supposed, that the dynasty which succeeded ALEXANDER in his empire ascended the valley of the Oxus, the fertility of which would attract them. They would then be conducted by *Chitral* and *Iskardo* into *Baltí* or little Thibet, and the neighbourhood of *Kashmír*, and we may perhaps account for the early civilization of that beautiful valley in such a migration of Grecian colonists. The introduction of the religion of Muhammed into every country seems to have been fatal to historical annals of a prior æra, and I doubt not, that any traces which may have existed of the Macedonian inroad, or of the Seleucidæ, their successors, disappeared in that great revolution. The countries on the upper course of the Oxus lay beyond the line of *Tatár* invasion, and I infer from the modern language of *Badakhshán*, which is Persian, and its connexion with that country, that the tribes on the Oxus followed the destinies of the Persian empire. This would favor the supposition of their having been conquered by ALEXANDER. If we cannot bring ourselves to concede to these moderns the illustrious lineage of ALEXANDER THE GREAT, we must still receive their traditions as the most concurring proof of his having overrun these countries; and till some well-grounded argument can be brought forward to the contrary, I cannot for my own part deny the title of the chiefs to the honors which they claim. I received the information from natives of these countries, and as they entertained no doubt of its truth and authenticity, I have contented myself with recording that, upon which others will be able to enlarge and speculate.

## IV.—*On the "Topes" and Grecian Remains in the Panjáb. By Lieut.* Alexander Burnes, *Bombay Army.*

[Read at the Meeting of the 29th May.]

The "tope" or mound of *Manikyála* in the *Panjáb,* which is described and drawn in Mr. ELPHINSTONE's History of *Cabúl,* has long arrested the notice of the curious, both in India and Europe, some of whom take it to be a Grecian remain. We are deeply indebted to M. VENTURA, one of the Generals in RANJI'T SINGH's service, who lately laid open this mound at great expense, and put us in possession of much additional information regarding it. In my late journey through the *Panjáb* I went to *Manikyála,* and was fortunate enough to find several coins at that site, and to visit other buildings of a similar description to the "tope," which had not yet been seen or examined by Europeans. I was directed to the site of these by my friends Mons. ALLARD and COURT, who are also in RANJI'T SINGH's service; through the kindness of Mons. ALLARD, I had an opportunity when at *Lahore* of looking at the reliques found by General VENTURA at *Manikyála.*

There is a brief description of them published in the researches of the Asiatic Society, but I may here observe that they consist of three cylindrical boxes, of gold, of pewter, (or some mixed metal,) and of iron, which were found cased one within another, and placed in a chamber cut out in a large block of stone at the foundation of the pile. The gold box is about three inches long and one inch and a half in diameter; it is filled with a black dirty substance like mud, half liquid and mixed up with small pieces of glass, or amber, which would suggest an opinion, of its once being cased in a glass that had been fractured and shivered. Among this substance two coins or medals and a piece of string or twine were found. The smaller coin is of gold, and about the size of a six-pence, having a human figure, and the four pronged instrument which marks all the *Minikyála* coins. The other has two lines of rude characters, probably Hindú, on one side, and no writing or symbol on the reverse. Many other coins and reliques were found during the opening of the "tope," and the people informed me that some human bones were also disinterred; but it is unnecessary to make any further allusion to them on the present occasion.

On my arrival at *Manikyála* on the 6th of March, 1832, I had an opportunity of appreciating the valuable services of M. VENTURA, by a personal inspection of the "tope," now laid open to view by his persevering labours. He had first endeavoured to enter the building from below, but failed on account of the great solidity of the structure;

further observation had discovered to him that there was a shaft or well (if I can use the expression) descending into the building from the top of it, and here M. Ventura dug with success. He first cleared the well which extends about half way down, and is flagged at the bottom with large blocks of stone; he completed the work by heaving up these enormous blocks till he reached the foundation, where he was rewarded by the cylinders which I have described.

I was much struck with the position of the "tope" of *Manikyála*. It stands on a spacious plain, and may be distinguished at a distance of sixteen miles. I did not expect in a place of such celebrity to find my search for coins and antiques rewarded beyond the most sanguine expectation, since none are mentioned to have been seen by the gentlemen of the *Cabúl* Mission, and I only heard of those that M. Ventura had found in the tope. I procured however two antiques and about 60 or 80 copper coins, the value of which is much heightened by their corresponding with some of those that M. Ventura found in the interior of the "tope." One of the antiques is a ruby or piece of red crystal, cut into the shape of a head, with a frightful countenance and very long ears. While the other is an oval cornelian, bearing the figure of a woman holding a flower. She is gracefully dressed in a mantle, and the execution is superior*.

There have been several surmises thrown out as to the site of *Manikyála*, but I do not for a moment hesitate to fix it as *Taxilla*, since Arrian expressly tells us, that that was the most populous "city *between* the Indus and Hydaspes." On the latter river too I have been so fortunate as to stumble on the ruins of two cities opposite to each other, in which I believe will be recognized the Nicæ and Bucephalia of Alexander.

From the *tope* of *Manikyala* my inquiries extended to the neighbouring country, where several other buildings of a like nature are to be found. One of them is nearer the town of *Ráwil Pindí*, but it is much dilapidated, and my attention was directed to the village of *Usmán*, at the base of the Himálaya, and about 25 miles eastward of the Indus. On the north of a range of hills, and about a mile beyond the village, stands the "tope of *Belar*," as it is called by the inhabitants. I have annexed a sketch of this building, from which it may be inferred as of the same era as *Manikyála*. Neither of the buildings are perfect, and the tope of *Belar* differs in its greater length of body, though it has

* I regret extremely to say, that I have lost these valuable reliques, though impressions of them remain.

only a height of 50 feet, or 20 less than *Manikyála.* The general outline of the building too is somewhat varied, but the small pilasters are to be recognized, though the mouldings are numerous. The tope of *Belar* too has been opened from the top at some former period, and a section of it would present a counterpart of the plan of *Manikyála.* The few coins which I found here are similar to those of that tope, but no where did I receive the least trace or tradition regarding these buildings.

Like one in search of the philosopher's stone, I found myself referred from place to place, and at *Usmán* heard of a "tope" near *Peshâwar,* which I afterwards visited. It is about five miles from the city, but in so decayed a condition that the remains would not suggest any idea of the design without seeing those of the *Panjáb,* though they were one hundred feet high. There is however a "tope" in a perfect state of repair in the great *Khyber* pass to *Cábul,* and about 20 miles from *Peshâwar,* but I could not visit that building from the troubled state of the country. The natives of *Peshâwar* assured me also that there were 8 or 10 such "topes" in their neighborhood towards the *Kafir* country in *Swat* and *Búneir,* but the extent of their information leads no further than that they are "topes" or mounds of a prior age.

Seeing that the structures of *Manikyála* and *Belar* are both pierced by a shaft or well, descending into the building, I incline to an opinion that in these "topes" we have the tombs of a race of princes who once reigned in upper India; and that they are either the sepulchres of the *Bactrian* dynasty or their Indo-Scythic successors, mentioned in the Periplus of the second ARRIAN.

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## V.—*Note on Lieutenant Burnes' Collection of Ancient Coins. By* James Prinsep, *Sec. &c.*

[Read 29th May, 1833.]

Considering the short space of time allowed to a traveller, in his rapid passage through a foreign country, for the pursuit of objects not immediately connected with his errand; and the disadvantages which his own disguise, and the suspicions of the natives oppose to his search after the very rare relics of antiquity, which may have escaped destruction for twenty centuries in their country:—considering too that the inhabitants are unable to appreciate the value of such objects, and mostly ignorant of the demand for them among the inquisitive natives of the west; Lieutenant BURNES may be deemed very successful in the store of coins he has brought back from the Panjáb and from the valley of the Oxus.

Of pure Bactrian coins, he will be able to add at least three to the cabinets of Europe; upon one of which the name of EUTHYDEMUS is quite distinct: while of the Indo-Scythic or subsequent dynasties his store is so ample as to afford ten for the Bombay Literary Society, and as many more for our own cabinet, besides those he takes to Europe; and among the latter is one coin of the dynasty which supplanted the Macedonian princes of Bactria, calculated to excite much curiosity among antiquarians.

This abstruse subject is already deriving elucidation from the discovery of coins in many places, which is a forcible proof of the advantage of giving early publicity to such discoveries, and to the comments of antiquarians upon them: already has Dr. SWINEY at Karnál, following up his former researches, fallen upon two silver coins of APOLLODOTUS and MENANDER, neither of them duplicates of the two which rewarded Colonel TOD's labours. I hope soon to have it in my power to engrave these coins as a continuation of the plate I am now about to describe, in illustration of some of Lieutenant BURNES' collection. Captain WADE has also presented me with a few coins, obtained in his recent tour down the *Satlej*. To General VENTURA however we still look for our richest harvest, because his coins have a definite connection with an existing monument; and when that meritorious officer shall see how Lieutenant BURNES has taught us to appreciate his labours at *Manikyála*, we hope he will no longer think us unworthy of being made the medium of their introduction to the knowledge of the world.

*Macedonian and Syrian Coins.*

Having given in Plate V. a type of the coins of ALEXANDER, I need not stop to describe those brought from Persia by our traveller, a tetradrachma and two small coins of that conqueror in excellent preservation; the larger coin has a curious cypher composed of the letters P M H enclosed in a wreath; in numerals this would represent 148.

Captain WADE has presented me with a rarer silver coin of ALEXANDER, having a fine juvenile portrait of the conqueror before he assumed the horn of Ammon; and, on the reverse, Apollo seated on the peculiar oracular seat, holding an arrow pointed downwards, in the right hand (denoting clemency); his left hand resting upon a bow.

The epigraphe is ΒΑΣΙΛΕΩΣ ΑΛΕΞΑΝΔΡΟΥ ΘΕΟΠΑΤΟΡΟΣ ΕΥΕΡΓΕΤΟΥ. On the exergue, the letter C; and on the left, a peculiar three-pronged monogram, resembling the letter A.

This coin is not mentioned by PINKERTON, and would doubtless be designated by him RRRR or *rarissimus.* It is engraved as fig. 1 of Plate VIII. (of coins); it was procured in Asia Minor by Dr. MARTIN, the German physician, lately in RANJI'T SINGH's service, and by him given to Captain WADE.

To return to Lieutenant BURNES' collection.

*Pl.* VII. *fig.* 1, represents one of three beautiful coins of ANTIOCHUS VI. or THEOS, of Syria, during whose war with PTOLEMY PHILADELPHUS, Bactria revolted. These are supposed by PINKERTON to exhibit the most perfect examples, both of manly and of monetal beauty, to be found among ancient medals. They are however common enough. The Epigraphe is, ΒΑΣΙΛΕΩΣ ΑΝΤΙΟΧΟΥ ΕΠΙΦΑΝΟΥΣ. Device, Jupiter seated, holding a small victory.

*Fig.* 2. Another ANTIOCHUS, probably struck in Parthia, from the figure of the javelin-thrower.

*Bactrian Coins.*

*Figs.* 3, 4, 5, 6. These silver coins, tetradrachms, are known at once to be of Bactrian origin, from the sitting figure of *Hercules* holding his club, on the reverse, much in the same posture as that of *Jupiter* on the Syro-Macedonian coins. The epigraphe on fig. 3, a valuable coin and in fine preservation, is ΒΑΣΙΛΕΩΣ ΕΥΘΥΔΗΜ.. or " of king EUTHYDEMUS," the third king of Bactria. The only coin of this monarch hitherto known in Europe is described in MIONNET's *Description de Medailles Antiques;* PINKERTON says it is a gold coin, having " two horsemen with Bactrian tiaras, palms, and long spears" on the reverse; it is therefore quite different from the unique specimen before us.

*Fig.* 4 has the features of a different prince; the reverse is however similar to the last, and the three final letters of ΒΑΣΙΛΕΩΣ are visible: as are ..ΗΜ.. which can only form part either of Ευθυδ ΗΜος or of δΗΜητριος his son.

*Fig.* 5, of which there is a duplicate, is of a similar nature; the features corresponding with No. 3 or EUTHYDEMUS. There are two others of still ruder fabrication, distinguished by a more projecting forehead: they are illegible on the reverse.

*Fig.* 6. One of two silver tetradachms. These are more like Arsacidan coins, the stool on which the figure on the reverse sits having the form of those depicted in Vaillant; although the connection with the foregoing coins is very strong, the head dress and formal curls, appertain to the Persian monarchs. The inscription is in the *Pehlevi* character: some of the letters resemble badly executed Greek.

These coins are all from *Khoja-o-bán*, the ruins of an ancient city N. W. of *Bokhara*, whence numerous gems and antiques were also procured.

*Fig.* 8, was obtained from the same place. A gold coin of one of the Sassanian kings of Persia, supposed to be Sapor *(Shápúr)*. The name and titles are very distinct in the *Pehlevi* character. It is remarkable that the usual supporters of the fire altar, two priests or kings, are omitted; unless indeed the rude ornaments on each side are intended to represent human figures holding swords. A silver Sassanian coin delineated in Hyde's *Religio Veterum Persarum* has similar supporters. Lieut. Burnes has also a silver Sassanian coin; it is curious from the contour of the fire altar being fashioned into a human profile; it was found at *Khiva*. I have not found room to insert it.

*Fig.* 9. One of twenty small Sassanian copper coins, which are very abundant in the same neighbourhood. They have a good head on the obverse, and a very rudely executed fire altar on the reverse*.

*Fig.* 7. A square copper coin from *Shorkot,h*, a fortress twenty miles from the junction of the *Jelum* and the *Chunáb* (the Hydaspes and Acesines) where Alexander lost his fleet in a storm. It is by some thought to be the fortress of the *Malli*, in the assault of which he was wounded. All that can be read of the inscription is ΒΑΣΙΛΕΩΣ.... On the other side the inscription is in *Pehlevi*. This coin may be ascribed with tolerable certainty to Menander, both because it resembles in shape the coin of that prince in Col. Tod's plate, and because the three first letters of the word which follows ΒΑΣΙΛΕΩΣ have much the appearance of ΝΙΚ, or ΝΙΚΑΤΟΡΟΣ, the epithet applied to Menander according to Schlegel. Journal Asiatique, Nov. 1828. The standing figure however, on the obverse, and the curious emblem on the reverse, supposed by Col. Tod to be a portable altar, agree rather with his coin of Apollodotus.

*Pl.* VIII. *fig.* 2. I must here introduce a coin procured from the same place by General Ventura, for which I am indebted to Captain

* A gold *solidus* of the lower empire was also found at *Khoja-o-bán*, of rude fabrication:—it is either of Marcianus, or more probably Mauricius—inscription DN MAVRC.. TIb PP AVG. On the reverse, an angel holding the cross and globe with VICTORIA AVGGG. and below, CONOB.

the third
WADE; it is a copper or brass coin of Antiochus, ΒΑΣΙΛΕΩΣ ΑΝΤΙΟΧΟΥ, with a Grecian head on the obverse, and the perspective view of the after part of a boat on the reverse: the tiller of the rudder is worked from behind, as is even now the case in the river craft of the Indus. the date PIZ is 117 of the era of the Seleucidae
was generally the case in greek vessels &

A ruby seal antique, with a well-executed head of a Grecian female, was found at the same place.

*Figs.* 11, 12, 13, 15. The series of small copper coins found near *Manikyála,* and generally throughout upper India, which have a head on the obverse and a Bactrian horseman on the reverse, may be referred to the reign of EUCRATIDES I. since the gold coin from the neighbourhood of the Caspian Sea, described by BAYER, as having the same device on the reverse bears in legible characters the epigraphe "of the great king EUCRATIDES." Our coins of this type have never shewn us more than the words "King of kings," and in most of them (as fig. 13, ΒΑCΙΛΕΥ ΒΑCΙΛΕΥ) the Greek is so corrupted as to give the idea of a later epoch.

The type of the horse seems to have prevailed long afterwards in that part of the world, as fig. 14 evinces: it is a Hindú coin, of much later though of unknown date. The nagrí letters appear to be part of a larger inscription: their purport is therefore uncertain.

*Fig.* 10. A copper coin procured by Lieut. BURNES, in the neighbourhood of *Manikyála.*

*Obverse.* A king or warrior holding a spear in the left hand; and with the right sacrificing on a small altar (?). Epigraphe ΒΑCΙΛΕΥC ΒΑC...... ΚΑΝΗΡΚΟΥ.
C

*Reverse.* A priest or sage standing, and holding a flower in his right hand; a glory encircles his head; on the left, the letters ΝΑΝΑΙΑ —on the right, the usual Bactrian monogram with four prongs.

This coin is of very great value, from the circumstance of its being the only one out of many discovered in the same neighbourhood, upon which the characters are sufficiently legible to afford a clue to the Prince's name. In the onset however we are disappointed to find that none of the recorded names of the Bactrian kings at all resemble that before us*; yet there can be no doubt about any letter but that

* By way of convenience to those who have not the power of reference respecting the history of Bactria, to which I may often have to allude in the discussion of these coins, I subjoin a catalogue of its Kings, according to the authority of SCHLEGEL.—*Journal Asiatique,* 1828, *p.* 326.

preceding ΚΟΥ, which may be either Θ, Ρ, or C. By assuming this latitude in the reading I discovered a name which would agree as nearly as it could be expressed in Greek, with ΚΑΝΗΘΚΟΥ or ΚΑΝΗCΚΟΥ; and should my conjecture prove correct, the discovery of this coin will be hailed as of the greatest value by all who are engaged in the newly developed study of Bactrian antiquity. The coin was at first placed with the Society by Lieut. Burnes, but seeing its value, I thought it but just, after taking impressions and drawings of it, to place it in the discoverer's hands, for the personal satisfaction of numismatologists in Europe. I suppose it to be a coin of Kanishka, a Tartar or Scythic conqueror of Bactria.

According to Mr. Csoma de Körös, the name of Kaniska occurs in the Tibetan works as a celebrated king in the north of India, who reigned at *Kapila,* which is supposed to have been in *Rohilkhand,* or near *Hardwár.* His reign dates about 400 years after Sakya, when the followers of the Buddha religion had become divided into eighteen sects (the *Sakya* tribes, or *Sacæ)* under four principal divisions, of which the names both Sanscrit and Tibetan are on record*.

In Mr. Wilson's Chronological Table of the History of *Kashmír* (As. Res. xv. p. 81,) we find " Hushca, Jushca, and *Canishca,* three Tartar princes, who succeeded Domodara, in the kingdom of *Kashmír,* either reigning successively or synchronously. They introduced the Buddha religion under a hierarch named Nágárjuna, and were, according to the *Raja Taringini,* of *Turushca* or *Tatar* origin. The Sanscrit MS. places their reign 150 years before *Sacaysinha* (or Sakya Singh), but the learned translator in a note proves that the text was at first misun-

| | | |
|---|---|---|
| B. C. 255. | Theodotus I. | Fixed historically by Strabo, &c. |
| 243. | Theodotus II. | |
| 220. | Euthydemus of Magnesia. | |
| 195. | Apollodotus soter. | Alluded to by Plutarch Trogus and Arrian, their coins prevalent in Baroach, A. D. 200. |
| | Menander nikator. | |
| | Heliocles dikaios. | On the authority of Visconti and Mionnet, from a single medal. |
| | Demetrius. | Son of Euthydemus, doubtful if he reigned in Bactria. |
| 181. | Eucratides I. | Artemidorus calls him the " Great King." |
| 146. | Eucratides II. | Murdered his father and was himself slain. |
| 125. | Destruction of the empire by the Tartars and the Scythians or Sacæ. | |

* Csoma's Life of Sakya, MS.

derstood, and that the passage intended to express "150 years *after the emancipation* of the Lord SAKYA SINHA."

The epoch of SAKYA, (the fifth BUDDHA, or GOUTAMA,) is determined by concurrent testimony of the Ceylonese, Siamese, Pegue, Burmese, and Chinese æras, which are all founded on the birth or death of the Buddha legislator, and, though all differing more or less, concur in placing him between the limits of 544 and 638 years B. C.: the Raj Gúrú of Asam, a Pundit well versed in Buddha literature, fixes the *Nirwan* or emancipation of SAKYA-MUNI in 520 B. C.* Taking then from this epoch an interval of four hundred years to the reign of KANISKA, the latter would fall near the end of the second century B. C. We know from other sources, that the overthrow of the Bactrian dynasty by the Scythian or *Sakyan* tribes happened in 134 B. C. (125 by SCHLEGEL.) The present coin therefore confirms the fidelity of the *Raja Taringini* as a historical work, and leaves no doubt of the epoch of SAKYA.

Mr. WILSON finds grounds for throwing back the termination of the reign of ABHIMANYA, CANISHCA's successor, from B. C. 118, as given in the *Raja Taringini*, to B. C. 388, because "*Kashmír* became a Buddha country under Tartar princes *shortly after* the death of SAKYA;" but from Mr. CSOMA's subsequent examination of the Tibetan sacred books, in which the three periods of their compilation are expressly stated; "first, under SAKYA himself (520—638 B. C.) then under ASHOKA, king of *Pataliputra*, 110 years after the decease of SAKYA, and lastly by KANISKA, upwards of 400 years after SAKYA"—little doubt can remain that the epoch as it stands in the *Raja Taringini* is correct.

There are other circumstances connected with the Bactrian coins, which tend to confirm the supposition of a Buddhist succession to the Greek princes. In the first place, the reverse ceases to bear the formerly national emblem of the Bactrian horseman with the Macedonian spear, and in its place a sage appears holding a flower, and invariably having a glory round his head, proving him to be a sacred personage†; secondly, although upon the first coins of the dynasty we find the inscription in Greek characters—(a custom which prevailed under the Arsacidæ also, and continued under the first Sassanian princes;) still upon coins of the same device, but probably of later fabric, we find the same kind of character which appears upon the Delhi and Allahabad pillars:—the same which is found at Ellora and in many ancient caves and temples

* Orient. Mag. iv. 108.

† (See Col. TOD's Coins 11, 14; Mr. WILSON's Plates, fig. 1, 2, 6, 7; and this Journal, Plate ii. figs. 17, 18.)

of central India, and is held in abhorrence by the Brahmans, as belonging to the Buddhist religion*.

I need not repeat Mr. Wilson's opinion, drawn from other grounds, that the *tope* of *Manikyála,* in the neighbourhood of which these coins are found, is a Buddhist monument, but it receives much confirmation from the discovery of this coin of the Sakyan hero Kanishka.

Having thus far endeavoured to reconcile the coin before us, and others of the same class to the *Sakyan* dynasty, to which the term Indo-Scythic very aptly applies, we may reasonably follow up the same train by ascribing the next series, which exhibit, on the reverse, a Brahmaní bull, accompanied by a priest in the common Indian *dhotí,* as the coins of the Brahmanical dynasty which in its turn overcame the Buddhist line. Colonel Tod includes these coins in the same class as the last, and adduces his reasons for referring them to Mithridates, or his successors, of the Arsacidan dynasty, whose dominions extended from the Indus to the Ganges, and to whom Bactria was latterly tributary. Greek legends "of the King of kings," &c. are visible on some, and what he supposes to be *Pehlevi* characters on the reverse: but I incline to think these characters of the Delhi type, and the Bactrian Monogram should decide their locality. Mr. Wilson and Schlegel, both call them Indo-Scythic, and the latter, with Col. Tod, names the figure "Siva with his bull *Nandi*†." Mr. Schlegel thinks it curious that such marks of the Hindú faith should appear on these Tartar coins, but considering the Indian origin of the Sacæ, does not this rather prove the same of their successors, instead of their Tartar descent? It is more curious that the fire-altar should continue on all of the series, but the fact of its being a fire-altar at all is still matter of great uncertainty.

* See translation of portions of the Salsette and Ellora inscriptions by Major Wilford, As. Res. v. 140, which shews them all to refer by name to Sakya. Mr. A. Stirling, As. Res. xv. 314, says of some similar inscriptions on the *Udaya Giri* hill in Orissa. "The Brahmans refer the inscription with horror and disgust to the time when the Buddhist doctrines prevailed. I cannot however divest myself of the notion that the character has some connection with the ancient *Prakrit,* and I think an explanation is to be looked for only from some of the learned of the Jain sect." What has become of the key to this and other ancient Sanskrit alphabets, which Wilford says he fortunately discovered in the possession of an ancient sage at Benares?

† "Ce qui me parait la circonstance la plus remarquable dans ces medailles, ce sont ces preuves du culte brahmanique adopté par les rois Tartares. Ils regnaient donc certainement sur des provinces ou ce culte était etabli."—*Journal Asiatique, Nov.* 1828.

*Fig.* 16. Copper coins of this device are met with throughout Upper Hindústan:—they constitute the third series of Colonel TOD's plate, and some in his possession have decided Greek characters upon them. On the *obverse* is the same warrior with spear and altar. On the *reverse* is what he supposes to be a priest about to sacrifice the bull; but in the coin before us the *dhotí* is so precisely the costume of the Brahmans, that it inclines rather to look upon the animal (especially as he has the hump) as the sacred bull of this country, denoting the prevalence or predominance of the Brahmanical faith in the Indian dependencies of MENANDER or EUCRATIDES' dominion.

*Fig.* 18. This type of coin is if any thing more common than the last: and the inscriptions are no longer Greek; but either of the unknown character of the Delhí column or genuine Hindí. The figure astride upon the elephant is always much out of proportion, and the *Raja* with the altar more rudely executed. The elephant is, like the horse, preserved in subsequent coins of the Hindús; thus

*Fig.* 17 represents one of these procured by Lieut. BURNES in his tour. The same device is still common in Southern India. The form of the Nagrí characters on this and fig. 14 agrees with those on copper grants of land 7 or 800 years old.

I do not mention Lieut. BURNES' Muhammedan coins, as it is better to keep them distinct from the present engraved series, to which I may have soon to add a valuable supplement, containing a selection from Dr. SWINEY's and General VENTURA's discoveries. My task increases upon me daily, but I shall be amply rewarded if my humble notice of the discoveries of others shall, by connecting them with ancient history, eventually turn these most interesting reliques to the true end of numismatic study.

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## VI.—*Astronomical Observations at Barelly. By* H. S. Boulderson, *Esq.*

The 4th No. of the Journal of Science for Oct. 1832 contains observations of the transit of Mercury in May last made at Hull, Lat. 53° 45′ 57″ N. Long. 1′ 21″ W. As the longitude of the place of observation at Hull is probably very correct, this gives the means of gaining to some degree of certainty the longitude of the few places in India where the transit was observed. There is a considerable uncertainty in the place of Mercury at the transit. At least the times of conjunction in AR. gained from the elements given in the Naut. Alm.

Pl. VII

# BACTRIAN COINS

J. Prinsep del. et sculp.

and those in the Berlin Ephemeris differ considerably. With a view only to finding difference of longitude between places where the transit was observed—this is of no great consequence. The difference of declination of the Sun and Mercury at 0′ in AR appears to be about 9′2″.174, and this has been assumed, as also the following quantities :

| | | | | |
|---|---|---|---|---|
| Mercury's Eq. Hor. Parallax, | 15″.362 | Sun's | 0′ | 8″.5 |
| Semidiameter, | 5″.75 | ,, | 15 | 52.35 |
| Mercury's Hor. Mot. in AR. | − 1′ 18″.7 | in decln. | − 1′ | 8″.4 |
| Sun's ditto............ | + 2′ 24.5 | Sun's | + 0 | 42.7 |

The Semr. of Mercury obtained from the elements in the N. A. is 5″.8 In the Berlin Ephemeris it is given 5″.37. The quantity 5″.75 has been taken as the result of the measurement of the planet's diameter at Geneva, contained in the 3rd No. of the above Journal.

| | May. | h. | m. | s. |
|---|---|---|---|---|
| The internal ingress of ☿ observed at Hull, mean time, | 4th, | 21 | 2 | 21 |
| Add time from conjunction in AR....... | | 2 | 21 | 9.44 |
| Mean time of ☌ in AR at Hull................ | 4th, | 23 | 23 | 30.44 |
| The internal ingress observed at Barelly..... | 5th, | 2 | 20 | 58 |
| Add time from conjunction in AR........ | | 2 | 21 | 34.22 |
| Mean time of ☌ in AR at Barelly.............. | 5th, | 4 | 42 | 32.22 |
| The internal ingress observed at Chupra......... | 5th, | 2 | 42 | 18 |
| Add time from ☌ in AR................ | | 2 | 21 | 39.286 |
| Mean time of ☌ in AR at Chupra........... | 5th, | 5 | 3 | 57.286 |
| The external ingress observed in Calcutta....... | 5th, | 2 | 53 | 24.2 |
| Add time from ☌ in AR.............. | | 2 | 24 | 58.38 |
| Mean time of ☌ at Calcutta.................. | | 5 | 18 | 22.58 |

Deducting 1 m. 21 sec. the longitude of Hull from the respective differences, the following longitudes from Greenwich result :

| | h. | m. | s. |
|---|---|---|---|
| Barelly.. | 5 | 17 | 40.78 |
| Chupra... | 5 | 39 | 5.85 |
| Calcutta. | 5 | 53 | 31.14 (Surveyor General's Office). |

The observations at the ingress at Geneva are stated to have been rather uncertain. The internal ingress gives a wide discrepancy, the external ingress gives for the mean time of ☌ in AR May 4th, 23 $^{h}$ 49 $^{m}$ 22 $^{s}$ ·62—a difference of longitude from Hull 25 $^{m}$ 52$^{s}$· 25 $^{m}$ 52 $^{s}$ ·18, or from Greenwich 24 $^{m}$ 31 $^{s}$ ·18. The longitude of the observatory at Geneva (Gautier's) is given 24 $^{m}$ 35 $^{s}$

The longitude of Barelly from the mean of 8 occultations of stars in Oct. and Nov. last is 5 $^{h.}$ 17 $^{m.}$ 40 $^{s.}$ 56 E. of Greenwich.

By the mean of the 2 largest stars$_{o}$ Sagitarii and $\gamma$ Capricorn it is 5$^{h}$ 17$^{m}$ 39$^{s}$ ·68.

The following emersions of Jupiter's first Satellite were observed at Barelly in 1832.

| | Mean time. | Difference from *Greenwich.* | Mean. |
|---|---|---|---|
| | h. m. s. | h. m. s. | |
| October 19th, | 7 52 7 | 5 17 39 | |
| 26th, | 9 47 48.9 | 5 17 40.9 | h. m. s. |
| Nov... 4th, | 6 12 48 | 5 18 0 | 5 17 35.7 |
| 11th, | 8 8 15.7 | 5 17 24.7 | |
| Dec... 4th, | 8 24 54 | 5 17 14 | |

From the Jour. As. Soc. for Nov. 1832.

| | | Difference *from Barelly.* |
|---|---|---|
| The mean of the observations in Calcutta (excluding the last) on the 19th Oct. 1832, gives the emersion.. .. .. | h. m. s.<br>8 28 3.5 | h. m. s.<br>0 35 56.5 |
| The mean of the three first on the 26th Oct. gives the mean time of emersion of 1st Satellite........ .. .. | 10 23 27 | 0 35 38.1 |
| The observation on the 4th Nov. | 6 48 38 | 0 35 50 |
| The mean of the four observations on the 11th Nov. gives the emersion of 1st Satellite................. | 8 44 5.5 | 0 35 49.8 |
| The difference of longitude deduced from Mercury's transit is............................ .......... | | 0 35 50.36 |

The mean times of the observations of occultations of stars made at Barelly are,

| | | | h. m. s. |
|---|---|---|---|
| October | 2nd, No. 2276 | Im. | 10 21 23.9 |
| | 7th, No. 2814 | Im. | 9 1 15 |
| | 28th, No. 2097 | Im. | 6 18 44.5 |
| | 29th, 0 sag. | Im. | 5 29 47 |
| Nov. | 1st, $\gamma$ Capric. | Im. | 8 28 44.7 |
| Nov. | 3rd, No. 2773 | Im. | 8 37 16 |
| | ,, No. 2778 | Im. | 10 8 37.3 |
| | ,, | Emer. | 10 40 12.4 |

VII.—*Notice of a Native Sulphate of Alumina from the Aluminous Rocks of Nipál. By* J. Stevenson, *Esq. Superintendent H. C. Saltpetre Factories in Behar.*

This mineral was purchased by myself from a Nipál merchant. It is called by the natives of Tirhút, *Sulajít* (rock sweat), and is used by the native doctors of this country to cure green wounds, or bruises. It is sold at the rate of two rupees weight for a rupee.

DESCRIPTION.

In small light lumps, colour brownish white—externally anhydrous—internally semi-crystalline—fracture slightly fibrous, with a lustre resembling asbestus—porous—containing small cavities, lined with scarcely perceptible needle-like crystals—adheres a little to the tongue. Taste acidulous saline—soluble in twice its weight of distilled water. Specific gravity not ascertained, but probably not quite double the weight of distilled water. Friable.

*Examination by Tests.*

| | |
|---|---|
| Turmeric paper, .............. | No change. |
| Litmus do...................... | Changed the blue to pink. |
| Muriate of Barytes,........... | Copious precipitate of Sulphate of Barytes. |
| Nitrate of Silver, ............... | No change. |
| Oxalate of Ammonia, .......... | Do. do. |
| Prussiate of Potass, ............ | Precipitate of Prussian-blue, but not copious. |
| Solution of Sub-carbonate of Potass, | Copious Precipitate of Alumina. |

A careful analysis of this mineral produced the following result:

| | |
|---|---|
| Sulphate of Alumina, .................. | 95.0 |
| Peroxide of Iron, ...................... | 3.0 |
| Insoluble matter (silex),................ | 1.0 |
| Loss, ................................ | 1.0 |
| | 100.0 |

VIII.—*Notice of a Native Sulphate of Iron from the Hills of Behar, and used by Native Dyers of Patna. By Ditto.*

DESCRIPTION.

In lumps—colour, externally, light yellow—internally, light grey,—with a tinge of blue fracture, earthy and rough granular—porous, slightly glistening, anhydrous—easily frangible, soft—not ponderous—adheres slightly to the tongue—taste a little acid, leaving a sensation of sweetness. Very friable—specific gravity not ascertained, but probably about 1,800.

*Examination by Tests.*

| | |
|---|---|
| Litmus Paper, .......... ..... | Changed the blue to yellowish red, afterwards to brown. |
| Turmeric do. ..................... | No change. |
| Muriate of Barytes,............ | Copious precipitate of Sulphate of Barytes. |
| Nitrate of Silver,............... | No change. |
| Oxalic Acid,........................ | A slight cloudiness. |
| Prussiate of Potass,............ | Copious precipitate of Prussian-blue. |
| Liquid Ammonia, .... ........ | Copious precipitate of Magnesia, tinged with oxide of Iron. |

A careful analysis of this mineral produced the following result :

| | |
|---|---|
| Sulphate of Iron,........................ | 39.0 |
| Peroxide of Iron, ..................... | 36.0 |
| Magnesia, ...................................... | 23.0 |
| Loss, ............................................ | 2,0 |
| | 100.0 |

NOTE.—The above two mineral substances are the natural productions of Behar and Nipál. They might be used largely in the arts, especially in the manufacture of Prussian-blue, Calico printing, and Dyeing ; I am not aware that they have been noticed by European Chemists. If they have, the notice has escaped my reading. I am informed that they may be had in large quantities, the Sulphate of Iron in particular. The specimen which I operated upon was purchased from Patna Bazar, where depôts of this mineral are established.

## IX.—*Notice of Analysis of the Ashes of four Indian Plants. By Ditto.*

The plants were subjected to calcination, similar to the method used to make kelp in Scotland, and the quantity of alkali ascertained by Brande's process. 100 parts contained as follows :

| Names of Plants. | Alkali per cent. | Muriate of Potass per cent. | Sulphate of Potass per cent. | Insoluble matter per cent. | Remarks, &c. |
|---|---|---|---|---|---|
| Spent Indigo plant, | 7 . 0 | 3 . 0 | 15 . 0 | 75 . 0 | In the neighbourhood of Singhea. |
| Poppy or Opium plant, | 7 . 0 | 22 . 0 | 20 . 0 | 51 . 0 | From Tirhút. |
| Tobacco plant, | 3 . 0 | 9 . 8 | 11 . 0 | 76 . 0 | Ditto. |
| Gada Purnah plant*. | 10 . 0 | 7 . 0 | 11 . 0 | 72 . 0 | Abundant in Tirhút. |

* The latter plant, called by the Natives of Tirhút *Gada Purna,* is much used by the *Dhobís* or native washermen. They collect and subject it to the operation of burning, using the ashes instead of soap. I am not acquainted with the botanical name of this plant, having never seen it in flower. It is almost unnecessary to add, that the alkali from the above plants is sub-carbonate of potass.

*Singhea, in Tirhút,* 2nd *May,* 1833.

## X.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 26th June,* 1833.

The Hon'ble Sir Edward Ryan, President, in the Chair.

The proceedings of the last meeting were read.

Mr. C. E. Trevelyan and Mr. E. J. Ravenshaw, proposed at the last meeting, were elected Members of the Society.

The Secretary submitted the following Report of the Committee appointed on the 27th March, for determining the best mode of continuing the publication of the Asiatic Researches.

*Report of a Special Committee appointed on the 27th March,* 1833, *to consider the best mode of publishing the future volumes of the Asiatic Researches.*

The statement which Baboo Ram Comul Sen, the native Secretary, submitted to the Society, at the Meeting of the 27th March, 1833, and which led to our appointment as a Special Committee, was calculated to discourage the printing of the Society's Researches altogether, by shewing that they had been unsuccessful in a pecuniary point of view, and had absorbed in the course of many years a large portion of the Society's funds. To this argument we cannot on the fullest consideration give our assent. The reputation of the Society, its character, nay indeed its very existence depends upon the publication of its Researches, and this is the chief object of the contributions of its members. Neither can we coincide with the Baboo in recommending, that the Transactions, if printed at all, should be printed in England. The expence will now be nearly the same in both countries; but the convenience of reference to authors, and of supplying matter for the current volume; and of arranging the papers while in the press, are fully sufficient motives for giving a preference to printing in India: and the pride of a national and independent existence should still further determine us to this course; the moment we transfer the printing of our Researches to England, we commit an act of *felo de se,* and merge at once into the subordinate character of a branch of the London Asiatic Society, as has been the fate of the Literary Societies of the two sister presidencies.

With regard to our present means of maintaining the publication of our Researches, we may state, that the present income of the Society is Sa. Rs. 400 per mensem: out of which at least 100 rupees may be set apart to cover printing expences, and this in the three years usually devoted to each volume will be ample for plates as well as letter-press. But as every measure of economy is called for, under existing circumstances, we strongly recommend that the octavo form be substituted for the quarto volume.

It will be remembered, that an octavo edition of the first twelve volumes has already been published in England, and this has probably found a more extensive circulation among the public than the badly printed volumes of the Calcutta edition. The new series therefore will fall in very well with the English edition, and be the cause of an increased sale. It is possible that some English Bookseller may undertake to reprint the intermediate volumes, 13 to 18, in octavo, to complete the series.

We concur in opinion, that the Medical Society should be called upon to contribute to our funds, for the use of that portion of our apartments permanently occupied by their Library, &c. and we recommend that an application be addressed to them to that effect.

It has been suggested by one of our Members that we should make the Museum a source of income, by charging for the admission of strangers to inspect it: but the majority of us deprecate the principle of such a charge, as tending to close the doors of knowledge to many who may be least able, though most willing, to seek it in our Library and Museum.

We are inclined however to approve of the suggestion of another Member, that a composition for the quarterly subscriptions should be allowed. The amount of composition at the Royal Society is fixed at 50 guineas, or ten years' subscription.

With reference to the more limited scale of the Asiatic Society, and the higher ratio of its subscriptions, we think that Rupees 500 or 32 goldmohurs, which would be seven years' subscription, including the admission fee, might be adopted as the amount of composition for new Members; with a proportionate scale of rates for those who are already Members, should they desire to compound for their future subscriptions.

*June* 19, 1833. (Signed) John Tytler,
R. Benson,
J. R. Colvin.

Resolved, 1. That the Committee's recommendation with regard to the octavo Edition be adopted.

2. That the Secretary communicate with the Medical Society respecting the proposed contribution to our funds.

3. That the Society approve generally of the suggestion for the optional composition of the quarterly subscriptions, and that Dr. J. Tytler, Baboo Ram Comul Sen, and the Secretary be requested to draw up a table of the scale of payments, founded on the value of life and period of residence in India, as shewn by the Societies' subscription list.

The substance of a report from the Committee, on the boring experiment, was also communicated; but, as it had not received the signatures of all the Members, the discussion of the subject was adjourned till the next meeting.

*Library.*

The following books were presented:

Transactions of the Society of Arts, &c. vol. xliv. pt. 1. *By the Society.*

Archæologia, vol. xxiv. *By the Antiquarian Society of London.*

Read a letter from the Rev. W. Yates, to the President, presenting his metrical translation, in manuscript, of the *Nalodaya*, or History of King Nala, a Sanskrit Poem; with a copious analysis, and remarks on the various kinds of Sanskrit alliteration.

Resolved, that the work be made over to the Calcutta Committee of the Oriental Translating Fund.

*Museum.*

Read correspondence with W. H. Macnaghten, Esq. Chief Secretary to Government, respecting the transfer of the large statue of Gautama, deposited with the Society in 1825, to the Burmese Envoys; the Government agree to defray the expence incurred by the Society in setting the statue upon its pedestal.

A spotted Deer, and an Elk, with a pair of his horns, were presented by John Bell, Esq.

A further specimen of fossil bone, and a mass of the fossil shell conglomerate of Jabalpúr, were presented by Dr. Spilsbury.

*Antiquities.*

Read a further note on one of Lieut. Burnes' coins, by the Secretary. Also a notice on the origin of the *Sakya* sects, by M. A. Csoma de Koros.

## XI.—*Miscellaneous.*

*Synopsis of the Winds, Weather, Currents, &c. between Bombay and Suez, throughout the Year. By Captain* J. P. Sanders, *&c. Bombay.*

| Month. | Winds and Weather, 1° off Bombay, from thence to Mocha. | Winds and Weather between Mocha and Coseir. | Winds, &c. between Coseir and Suez. | Currents between Bombay and the Red Sea. | Currents in the Red Sea. | Remarks. |
|---|---|---|---|---|---|---|
| Janry. | Pleasant land and sea breezes, extending 50 or 60 miles off shore, when N. E. winds to N. N. W. may be experienced; moderate breezes from the N. E. from thence to the Straits of Babelmandel, where a southerly wind is experienced. | From Mocha to Lat. 19° N. the winds are strong from the southward; from thence to Coseir, frequent fresh north-westers, and moderate southerly winds, for 2 or 3 days. Fine pleasant weather. | Strong winds from N. W. and N. N. W. interrupted by occasional breezes from the south, lasting two or three days. | Approaching Socotra, the current sets S. W. running more to the westward on nearing the Straits of Babelmandel. | Generally setting to the southward, when N. W. winds prevail. | In Mocha roads the fresh southerly winds cause a very high sea, which renders communications with the shore difficult. In Aden, Bark Bay, Juddah, and Suez, fine weather and smooth water. In crossing from India, to the Red Sea, a long swell may be expected from N. E. |
| Febry. | Land and sea breezes, generally as in January, but occasionally moderate north westers, blowing home to the Malabar Coast. As far as the Straits fine strong breezes from the E. N. E. and N. E. then southerly winds. Fine pleasant weather. | Strong north-west and light southerly winds. | Same as in January. | Same as in January. | Same as in January. | Same as in January. |
| March, | Land and sea breezes less regular than in February, moderate breezes from the N. W. more prevalent. From Bombay to Mocha, wind not so strong as in February; swell still continues. | Wind north-westerly, as strong as in February; little or no southerly wind. | Do., with the exception of south winds being less frequent in the sea of Suez. | Same as in January. | Same as in January. | Same as in January. |
| April, | Variable weather, with moderate winds from N. W. to west, and occasional intervals of land & sea breezes; from thence to Mocha, weather occasionally unsettled, winds extremely variable, and blowing occasionally from every point. On the Arabian shore N. E. and easterly winds prevail, as far as the straits, then southerly winds. | Southerly winds seldom extending beyond Gebel Tor, while north-west winds become more frequent, between Juddah and Coseir. | Same as in March. | Current begins to incline to the N. E. near Socotra. | Same as in January. | Same as in January, but no swell. |

*Synopsis of the Winds, Weather, Currents, &c. between Bombay and Suez, throughout the Year. By Captain J. P. Sanders, &c. Bombay.*

| Month. | Winds and Weather, 1° off Bombay, from thence to Mocha. | Winds and Weather between Mocha and Coseir. | Winds, &c. between Coseir and Suez. | Currents between Bombay and the Red Sea. | Currents in the Red Sea. | Remarks. |
|---|---|---|---|---|---|---|
| May, | Cloudy unsettled weather with breezes from west to N. W. towards the latter, and occasional squalls from the southward; from thence to Mochá, westerly winds prevailing; near the Arabian shore, more southerly. In the vicinity of Socotra, variable winds prevail. | Winds variable, north-westers occurring more frequently, between Juddah and Mocha. Between Juddah and Coseir north-westerly winds most prevalent. | Wind strong from N. W. and N. N. W. occasional squalls from the S. E. of no long duration. | Between Socotra, and the Arabian Coast, current sets to the northward and eastward. | Same as in January. | In Mocha roads, strong either N. or S. winds causing a confused swell, with intervals of land and sea breezes. In Coseir the wind blows at times strongly from the N. W. causing a constant swell, from the exposed state of the anchorage. Crossing from India, little or no swell. |
| June,. | Squally from the N. W. and S. W., with heavy rains and cloudy weather, the monsoon generally commencing between the 6th and 16th; from thence to Mocha, fresh gales from the W. S. W. and S. W. extending to the Meridian of Guardafui; from thence moderate westerly winds prevail, to the Straits, where light N.-westerly airs are met with. | Near Mocha, land and sea breezes in the early part of the month; occasionally north-westers with rain. Between Juddah and Coseir north westers prevail. | Same as in May. | Near Socotra, current sets strong to the E. and on the Bombay bank, when the monsoon has set in, a northerly current will be experienced. | Same as in January. | Light northerly winds and sultry weather in Mocha Roads. At Juddah, land and sea breezes, when the north-westers are not blowing. A very high sea would be experienced, in crossing from India, especially near Socotra. |
| July, | Off Bombay, strong westerly winds, and squally; beyond, strong gales from the W. S. W. and S. W. extending to the meridian of Guardafui; from thence westerly winds of moderate strength prevail, as far as Babelmandel, when light north-westerly airs are met with. | North-westerly winds prevailing, occasionally strong. Southerly winds seldom blowing, and of short duration. | N. W. winds prevalent, and blowing with great violence. | On the Bombay bank, a southerly set. Between the Arabian Coast and Socotra are strong and variable; shift suddenly; run 50 or 60 miles per day. | Variable and partial, governed by the turns of the Coasts, and generally setting to the southward, with N. W. winds. | At Mocha, land and Sea breezes prevail, when the weather is settled. Crossing from the Red Sea, a high sea would be experienced. |
| August, | Moderate breeze and cloudy; squalls less frequent near Bombay. Between Bombay and Mocha, the | Near Mocha, variable winds; towards Coseir northerly winds gene- | Same as July. | On the Bombay bank, the current the same as in | Same as July. | At Mocha, the winds and weather the same as in July, and at Coseir and Suez, north- |

| | | | | | | |
|---|---|---|---|---|---|---|
| | same as in July, with the exception of the wind being more moderate. | rally met with. | | July. Between the Arabian Coast and Socotra the current sets to N. and N. E. | | westers still prevailing: at Juddah, pleasant weather, occasional N.-westers. Crossing from India a high sea may be expected, especially at the mouth of the Gulph. |
| Sept. | Winds variable from the westward, sometimes light airs from N. E., near Bombay.<br>From Bombay to Mocha, for the most part westerly, with occasional squalls from the W. S. W. and N. W. | Variable winds, with occasional breezes from the north-west, lasting many days. | Weathermore variable, than in July. | Variable. | Same as July. | At Mocha, light southerly winds prevail: sultry weather; smooth water.<br>Crossing from India, in the early part, a westerly swell; little or no sea at the latter part of the monsoon. |
| October, | N. E. winds extend about 40 or 50 miles from the Coast of India, when E. N.E. winds occur; thence to Mocha, moderate winds from N. E., extending as far as the Arabian Coast, when it changes to E. S. E. and S. E. At the entrance of the straits, south winds and unsettled weather. | Southerly winds now set in near Mocha, and at times near Coseir; at the latter place, north-westers still prevail, at times strong, and lasting several days. | Moderate from the northward. Weather unsettled. | Variable. | Same as July | Crossing from India, no sea will be encountered.<br>At Mocha, light winds and sultry weather. |
| Nov.. . . | North-westerly winds prevalent off the Coast of India, from thence to Mocha E. N. E. and N. E. winds.<br>At the entrance of the straits a southerly or south-easterly wind, with unsettled heavy weather. | Southerly winds prevail near Mocha, and light S. winds at Coseir: with north-westers sometimes strong at Coseir.<br>North-westers prevalent at Coseir, sometimes strong. | Same as in October. | Approaching the Red Sea, the current now sets S. W. and west. | Same as July. | Southerly winds now set in at Mocha, and more frequent at Juddah, Coseir, and Suez.<br>In crossing from India, no sea will be experienced. |
| Dec..... | Land and sea breezes extend about 50 miles, when N. E. to N. N. W. winds may be experienced, the N. E. monsoon now being set in; from thence to Mocha, the same as in January. | From Mocha to Lat. 18°. N. southerly winds more frequent in the northern parts of the sea of Suez, lasting from 2 to 5 days, some times blowing fresh above 18°. | Variable and unsettled. | Same as in November; the westerly current near the Red Sea encreasing in strength. | Same as July. | Fresh southerly winds, with a heavy swell in Mocha Roads. Pleasant, cold weather at Coseir and Suez.<br>Crossing from India, little sea will be incountered. |

*Meteorological Register, kept at the Assay Office, Calcutta, for the month of June, 1833.*

| Day of the month. | Barometer reduced to 32° Farh. | | | | Thermometer in the Air. | | | | | Depression of moist-bulb Thermometer. | | | | Hair Hygrometer. | | Rain. | Wind. | | | Weather. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Minimum at 4½ A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | At 10 A. M. | At 4 P. M. | Inches. | Morning. | Noon. | Evening. | Morning. | Noon. | Evening. |
| 1 | ,481 | ,500 | ,424 | ,468 | 87,5 | 91,4 | 99,5 | 94,7 | 87,3 | 4,8 | 5,6 | 8,2 | 3,9 | 95 | 88 | | E. | e. | S. | rain. | cloudy. | clear. |
| 2 | ,434 | ,489 | ,404 | ,437 | 87,5 | 92,5 | 100, | 94,3 | 87,2 | 6,7 | 6,8 | 7,3 | 4,0 | 92 | 90 | | s. e. | s. | S. | cumuli. | fair. | cum. cir. |
| 3 | ,384 | ,471 | ,404 | ,489 | 87,8 | 91,7 | 99, | 95,6 | 87,1 | 4,8 | 6,5 | 8,5 | 3,8 | 94 | 88 | | S. | s. | S. | cir-cum. | do | scud. |
| 4 | ,447 | ,521 | ,470 | ,546 | 86,8 | 92,5 | 100, | 95,7 | 87,5 | 4,4 | 5,8 | 8,2 | 4,5 | 95 | 89 | | S. | s. e. | S. | cir. strat. | cum. | do |
| 5 | ,509 | ,596 | ,508 | ,551 | 85,7 | 92,4 | 98, | 96,0 | 87,3 | 3,7 | 7,5 | 9,7 | 4,7 | 91 | 86 | | S. | s. | s. | haze. | do | clear. |
| 6 | ,512 | ,611 | ,472 | ,533 | 82,2 | 91,8 | 97,5 | 96,5 | 88,1 | 5,0 | 7,3 | 11,5 | 5,7 | 92 | 83 | | e. | s. e. | o. | nimbi. | cum. strat. | do |
| 7 | ,472 | ,504 | ,428 | ,488 | 84,0 | 92,7 | 98, | 96,4 | 88,2 | 7,6 | 7,8 | 11,0 | 4,5 | 89 | 84 | | s. | e. | s. e. | cirri. | clear. | do |
| 8 | ,535 | ,550 | ,442 | ,607 | 87,1 | 93,0 | 100, | 97,2 | 88,3 | 3,0 | 7,5 | 10,1 | 9,4 | 89 | 86 | | s. e. | s. | S. E. | nimbi. | do | do |
| 9 | ,606 | ,687 | ,607 | ,732 | 86,0 | 93,7 | 96, | 95,8 | 79,1 | 4,2 | 7,5 | 10, | 4,2 | 90 | 87 | | s. | s. | n. w. | haze. | do | hard.raing.n.wr. |
| 10 | ,727 | ,735 | ,730 | ,793 | 79,1 | 90,4 | 93, | 88,7 | 77,8 | 3,9 | 6,6 | 7,5 | 4,2 | 92 | 89 | 1,08 | o. | s. | S. | cir. strat. | do | rain,2n.wrs. |
| 11 | ,682 | ,756 | ,636 | ,666 | 81,3 | 88,3 | 93,5 | 92,4 | 86,7 | 5,5 | 5,5 | 6,8 | 6,4 | 94 | 92 | ,90 | S. | s. | S. | cumuli. | do | banks s. e. |
| 12 | ,588 | ,650 | ,528 | ,587 | 85,0 | 89,7 | 95,7 | 93,4 | 86,2 | 5,0 | 5,7 | 16,3 | 4,7 | 93 | 85 | | S. | s. | S. E. | clear. | do | clear. |
| 13 | ,563 | ,592 | ,461 | ,548 | 86,1 | 90,4 | 96, | 95,2 | 87, | 5,4 | 5,8 | 7,6 | 3,8 | 95 | 90 | | S. | S. | S. E. | nimbi | do | do |
| 14 | ,506 | ,552 | ,484 | ,559 | 86,2 | 90,7 | 95,7 | 94,8 | 87,7 | 5,2 | 5,8 | 8,5 | 5,6 | 95 | 88 | | S. | S. | S. | hazy. | do | do |
| 15 | ,535 | ,666 | ,535 | ,628 | 86,7 | 92,0 | 95, | 93,4 | 83, | 5,4 | 6,0 | 7,5 | 6,7 | 93 | 89 | | S. | S. | S. | clear. | rain. | slight. |
| 16 | ,613 | ,685 | ,571 | ,686 | 83,2 | 91,6 | 94,5 | 94,0 | 86,8 | 3,2 | 7,2 | 9,5 | 4,8 | 92 | 87 | 0,18 | o. | o. | S. S. | nimbi. | do | clear. |
| 17 | ,615 | ,665 | ,550 | ,588 | 85, | 90,5 | 94,0 | 94,0 | 84,5 | 3,6 | 6,4 | 9,4 | 5,2 | 93 | 86 | | s. | s. | s. | cumuli. | cumuli. | threatening |
| 18 | ,522 | ,544 | ,420 | ,487 | 85,2 | 90,4 | 94,3 | 93,6 | 86,0 | 4,7 | 6,2 | 8,5 | 9,8 | 94 | 88 | | s. | s. e. | S. | stratus. | overcast. | clear. |
| 19 | ,449 | ,476 | ,383 | ,435 | 83,7 | 91,1 | 100,0 | 95,0 | 87, | 5,9 | 9,4 | 10,5 | 4,9 | 87 | 82 | | o. | s. | S. | do | cumuli. | do |
| 20 | ,377 | ,450 | ,364 | ,421 | 86,3 | 92,5 | 100,2 | 94,1 | 87,5 | 5,6 | 8,9 | 8,4 | 5,7 | 89 | 89 | | s. | S. | S. | do | do | do |
| 21 | ,405 | ,462 | ,376 | ,455 | 86,7 | 90,6 | 98,5 | 95,4 | 87,5 | 8,7 | 9,0 | 6,6 | 3,9 | 90 | 87 | | s. | o. | s. | banks. | rain. | do |
| 22 | ,428 | ,480 | ,441 | ,490 | 85,2 | 90,7 | 95,7 | 88,6 | 82,0 | 10,2 | 5,5 | 7,1 | 2,8 | 91 | 80 | 0,08 | s. | s. | s. e. | rain. | overcast. | do |
| 23 | ,473 | ,440 | ,472 | ,477 | 80,4 | 90,5 | 96,2 | 89, | 81,0 | 2,2 | 5,7 | 6,2 | 5,7 | 92 | 82 | | E. | NE. | E. | haze. | clear. | do |
| 24 | ,459 | ,490 | ,443 | ,504 | 81,0 | 90,0 | 97,2 | 91,5 | 82,5 | 2,2 | 7,2 | 7,0 | 3,8 | 90 | 90 | 0,10 | o. | s. e. | o. | clear. | do | sq.cum.str. |
| 25 | ,457 | ,505 | ,432 | ,500 | 82,6 | 87,8 | 90, | 87,0 | 81,7 | 2,4 | 5,8 | 4,0 | 2,9 | 95 | 95 | | o. | N. W. | o. | cir. cum. | fair. rain | gentle. |
| 26 | ,498 | ,556 | ,471 | ,533 | 80,2 | 86,7 | 90, | 89,2 | 83,5 | 2,4 | 4,4 | 4,6 | 4,1 | 96 | 94 | 0,36 | o. | s. | s. o. | nimbi | do | clear. |
| 27 | ,498 | ,605 | ,521 | ,578 | 80,2 | 86,6 | 88,5 | 87,5 | 84,0 | 2,2 | 4,0 | 4,7 | 3,2 | 95 | 95 | 0,22 | o. | o. | o. | cumuli | do | do |
| 28 | ,516 | ,628 | ,501 | ,593 | 84,0 | 87,7 | 92,7 | 91,7 | 84,3 | 4,0 | 5,5 | 8,3 | 3,2 | 94 | 89 | | S. | S. | S. | clear. | do | cirri. |
| 29 | ,528 | ,612 | ,521 | ,570 | 84,2 | 87,7 | 92,5 | 89,5 | 81,2 | 3,7 | 4,8 | 4,7 | 5,5 | 95 | 95 | | S. | S. | N. S. | cum strat | do | n. cirri. |
| 30 | ,518 | ,596 | ,530 | ,553 | 84,0 | 88,7 | 93, | 85,7 | 84,2 | 4,0 | 4,5 | 4,6 | 4,5 | 95 | 94 | 0,12 | S. | S. E. | S. | overcast. | do | haze. |
| Means | 29,511 | ,569 | ,485 | ,550 | 84,3 | 90,5 | 95,8 | 92,8 | 85,1 | 4,6 | 6,4 | 8,1 | 4,9 | 92,5 | 88,2 | 3,04 | unsteady | | | cool without rain. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory, and the Sunday entries are filled in by interpolation. The Instruments for 5 A. M. and 10 P. M. are observed daily in the south veranda of a house near the Cathedral. The proper corrections for the several instruments used will be furnished at the conclusion of the year.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 19.—*July*, 1833.

## I.—THE BIRTH OF UMA'—A LEGEND OF HIMA'LAYA,

By Ca'lida'sa,

*(being the first Canto of his great poem the* Cuma'ra-sambhava).

**The Sanscrit text translated into corresponding English measure, with notes and illustrations.**

### ARGUMENT.

*Nature and site of* Hima'laya, (1.) *His pre-eminence among mountains, how shown,* (2.) *Not disparaged by frost,* (3.) *Description of his sublime appearance and various wonders,* (4—16.) *His designation as King of Mountains by* Brahma, (17.) *His marriage with the nymph* Ména, (18.) *Birth and description of their first-born son, the mountain* Maina'ca, (19, 20.) *New birth, from the same pair, of* Satí, *once daughter of* Daxa *and wife of* Siva, (21, 22, 23.) *Appearance and growth of the beautiful daughter thus born anew,* (24, 25.) *Her designation as* Pa'rvatí *and as* Uma', (26.) *Prized above all things by her father* Hima'laya, (27, 28.) *Her childhood and education,* (29, 30.) *Her more mature youth,* (31, 32.) *Description of her person,* (33—50.) *Her destiny as future wife, the second time, of* Siva, *made known to her father,* (51, 52, 53.) Siva, *after long mourning for* Satí, *comes to Himálaya to perform austerities,* (54, 55.) *His troop of attendant Gods described,* (56,) *and his Bull,* (57.) Siva *then commencing his austerities,* (58,) *is worshipped by* Hima'laya, (59,) *and at his command by his daughter* Pa'rvatí; *whose influence on* Siva, *together with* Siva's *influence on her, are described,* (60, 61.)

The lines marked * thus in the first five stanzas are those which *exactly* represent in structure the *pádas* or quarters of stanzas in the original—consisting of an Iambus or Spondee, a Bacchius, an Anapæst and Bacchius ; thus,

⏓ — ⏑ — — ⏑ ⏑ — ⏑ — —

This hendecasyllable measure, called by the Hindus इन्द्रवज्र or *Indra's thunderbolt*, (probably, because in one of the Brahmanas of the Sâma Véda, Indra is said to have aimed his thunder at the demon Vritra by means of Sanscrit metres !) extends through the whole of this canto, with the exception of the last stanza, the 61st : and is next to the *Anustup* or ordinary loose Iambic, the most frequently used, beside being one of the most harmonious, measures of Sanscrit poetry. In its application to the less measured structure of English syllables, its rhythmical effect is perhaps better represented by the following musical notation, than by any terms of prosody : (the semiquavers denoting the rapid or short syllables, and the quaver and all beyond, without distinction, denoting the long :)


a notation which may also serve to shew the reason why the rigorously *exact* imitation of this, as of other measures belonging to classical ancient languages, is not accordant with the genius of our English metrical composition. The Teutonic ear, content with the regularly recurring *accent* in every third syllable, and insensibly attaching the idea of equality of time to this recurrence, as in the musical bars above written, does not acknowledge any law that should thus *perpetually* and *invariably* distinguish the middle bar, by a dactylic subdivision, from the amphimacer of the bars preceding and following it : but allows, and even requires, for variety's sake, the mutual interchange of these different modes of subdivision, in the several repeated periods of the same rhythm. Such is the case with more or less variation in all the lines not marked with a star in the first four stanzas : and the plentiful intermixture of such lines is therefore more a matter of taste, to avoid what would be in English an intolerable uniformity, than a sacrifice to the mere ease of versification.

It is far different with the ancient languages of Greece and Rome ; which in the regulation of metre by *quantity* exclusively of *accent* exactly resemble the Sanscrit. In all these, the conception of time being adjusted rigorously to that standard of quantity, which counts two short syllables (or *Mátrás* in Sanscrit) equivalent to one long, the substitution in any lyric measure of dactyl for amphimacer, or anapæst for bacchius, is known to be impossible. Adopting therefore their standard, the most perfect conception may be attained by a classical scholar of our present Indian measure, by joining an *Alcaic* commencement to a *Sapphic* termination. Thus if in the first of the Alcaic odes of Horace, we transpose or slightly interpolate the ends of its two first lines, the middle of its third, and the beginning of its fourth, thus—we make the complete *Indra-vajra* stanza.

Vides ut altâ *nive candidum stet*
Soracte, nec *sustineant onus jam*
Silvæ labore *exanimes*, geluque
*En*, flumina *ut* constiterint acuto.

Or if we take the 22nd ode, which is in the Sapphic measure, a yet slighter alteration will suffice to give each line the Alcaic commencement necessary to make the same Indian metre ; thus,

1.

* IN regions far North, clad in deiform might,
The Mountain King rises, HIMÁLAYA hight:
* Whose giant form, stretching along in one sweep
* From th' Eastern main forth to the Westernmost deep,
Might seem, as it join'd them, the measuring rod
* Laid o'er the broad earth by its architect God.

---

*Vitæ integer qui*, scelerisque purus,
Non *ille* Mauri jaculis neque arcu,
Nec *felle tinctis* gravidâ sagittis,
*Mi* Fusce, *securus eget* pharetrâ.

Though this particular species of double dochmiac measure does not itself occur in Horace or in Pindar, it may be found sometimes in the choral strains of the Greek tragic poets—but in insulated lines only. Thus in the Persæ of Æschylus, the 5th strophe and antistrophe of the last choral song of lamentation contain the following regular *Indra-vajra* lines.

Stroph. Τί δ' οὔκ; ὄλωλεν μεγάλως τὰ Περσᾶν [v. 999.]
Antistr. Τραπέντα ναύφρακτον ἐρεῖς ὅμιλον [v. 1009.]

(each being followed by two lines in the kindred Indian measure called वंशस्थविलं)

The following commencement of a similar strain in the Antigone of Sophocles, (uttered by the unfortunate heroine herself,) is in the same measure:

Stroph. Ορᾶτε μ'ω γᾶς πατριᾶς πολῖται [v. 817.]
Antistr. Ἤκουσα δὴ λυγροτάταν ὀλέσθαι [v. 834.]

(in which we may also observe, no less than in the Alcaic, another peculiarity of our Indian measure, the *commonness* of the first syllable).

So is the commencement of a similar strain in vv. 431 and 439 of the Medea of Euripides, (p. 39, ed. Porson)—and the concluding line of another in vv. 763,771 of the Supplices of Æschylus, (p. 35,36, ed. Scholfield)—and others which it were needless to transcribe.

*St.* 1. *the measuring rod*
*Laid o'er the broad earth by its architect God.*

The words "*by its architect God*" are an addition to the expressions of the original, but not to the sense, even according to Hindu ideas: the earth's "measuring rod" presupposing a builder, viz. the creator Brahma. When we consider the Himálaya, in the words of the Baron de St. Croix, as a part of one "great chain of mountains which rising on the sides of Lycia, Pamphylia, and Cilicia, stretch across Asia from West to East, and after receiving the different names of Taurus, Paropamisus, Imaus, and Emodus, terminate at the sea that washes China," and thus join, as our poet declares, both oceans,—the comparison of the vast progressive range to such a rod, will scarcely be thought an unhappy one. But bating this, which is peculiar to our Indian author,—the image of an artificer, and even of an instrument of measurement, is not thought unworthy to represent the Supreme Being, and his absolute control of the most stupendous objects of the visible creation, in the pure theology of our inspired Scriptures. See Isaiah xi. 12, 15, &c. but I would particularly refer to two remarkable instances in the book of Job (xxviii. 25, and xxxviii. 3, 4): in the former of which the Hebræo-Arabic word מִדָּה (مُدَّة) applied to the

2.

Him once the gay hills, so they tell, all agreed
* To make the prime Calf of their glorious high breed ;
And MÉRU himself, skill'd in milking of yore,
Stood milker for all of the genial Earth's store :

---

measurement of the great waters, exactly answers in meaning to our Sanscrit मानं —as its derivative ממד (مُمَدّ) in the latter, which I now quote, might both from its form and its parallelism with the *cord* in the 4th line, be almost conceived to be synonymous with our मानदण्डः (the word not occurring elsewhere in Scripture.)

איפה היית ביסדי—ארץ Where wast thou, when I laid the foundations of the earth ?
הגד אם ידעת בינה Tell, if thou art acquainted with knowledge.
מי—שם ממדיה כי תדע Who disposed the dimensions (or dimensors ?) of it if thou knowest ?
או מי—נטה עליה קו Or who stretched over it the measuring line ?

*St.* 2. *Him once the gay hills, &c.*—The truly Indian legend of this verse is contained with somewhat more particularity in the 6th chapter of the Hari-Vansa, the last book of Vyása's sacred epic, the Mahábhárata.

शैलैश्च श्रूयते राजन् पुनर्दुग्धा वसुन्धरा ।
औषधीश्च मूर्त्तिमतीरत्नानि विविधानि च ॥ ३९ ॥
वत्सस्तु हिमवानासीन्मेरुर्दोग्धा न संशयः ।
पात्रं तु शैलमेवासीत्तेन शैला विवर्द्धिताः ॥ ४० ॥

And also in the 18th chapter of the 4th book or Skandha of a more recent mythological authority, the Bhagavat Purána.

वटवत्साश्च तरवः पृथग्रसमयं पयः ।
गिरयो हिमवद्वत्सा नानाधातून् स्वसानुषु ॥ २४ ॥

But the legend which has given to both these chapters of the Hari-Vansa and the Bhagavat respectively the title of *Prithví-dóha*, or " the milking of the earth," is not confined to the subject of these lines, i. e. to the Mountains and their chosen Calf Himálaya. The injunction of PRITHU to his obedient wife (or as some authorities have it, his daughter) PRITHVI, i. e. the Earth, extends to the suckling of all orders of the creation, from the ultra deified saints or Rishis down to the trees of the forest : each of which, according to the high authority first quoted, were desirous of the favour, and had its own Calf, its milker, and its appropriate milk or nutriment, drawn by him from the udder of Mother Earth in an appropriate pail. The fable is sufficiently curious and illustrative of Indian mythology in general, to be stated at greater length.

The Rishis chose for their prime calf, Soma, regent of the moon : and the sage Vrihaspati, son of Angiras, acting as milker for the rest, drew the pure milk of *austere and spiritual science* from the earth's breast into a pail composed of the metrical Vedas.—The celestial Gods chose Indra for their calf : and their milker Surya, or the Sun, milked the earth of *strength* in a pail of gold.—The Pitris or Dii Manes having chosen Yama (the Indian Pluto), for their calf, their milker, Fatal Time, drew from the earth's bowels the *sacred food offered to deceased ancestors*, into a pail of silver.—The Nágas or serpentine deities of the

Who, heeding their wish, at great Prithu's behest
* Gave freely, cow-like, of her swelling dark breast :
* And sparkling bright gems, with all healing herbs' power,
Gush'd out for this dear mountain-babe to devour.

---

realms below, having chosen Taxaka as their calf, and Dhritarástra as their milker, milked the earth of its *poisons* in a gourd pail.—The Asuras or malignant deities, choosing Viróchana, son of Prahlada, as their calf, and Madhu for their milker, milked the earth of *illusion* in a pail of iron.—The Yaxa demons, choosing Cuvéra (the Indian Plutus or Mammon) for their calf, (the milker not named,) milked the earth of *dissimulation* in an earthen pail.—The several descriptions of fiends and vampires, the Raxasas, Pisáchas, Bhútas, &c. all choosing Sumali for their calf, and Rajatanabha, (the silver-naveled goblin,) for their milker, drew *blood* from the teats of the earth, into a dead man's scull used for a pail.—The Gandharvas and Apsaras, the songsters and dancers of Paradise, choosing Chitraratha for their calf, and Vasaruchi for their milker, drew *perfumes* from the earth's bosom into a lotus pail.—The mountains having chosen, as we have seen, Himálaya as their calf, and Méru for their milker, milked the earth of *jewels* and *rich herbs* in a pail of stone.—Lastly, the trees, having chosen the Plaxa or holy fig-tree for their calf, and the Sâl tree for their milker, drew *buds* from the earth's bosom in a leafy pail.—So far the Mahábhárata : with which the Bhagavat disagrees in several minor particulars : both of these grave authorities, however, agreeing with each other, as I am happy to observe, in fully confirming the statement of our poet in this verse respecting his mountain King.

The Scholiast Nílakantha on the Mahábhárata makes the principal herb of which the Earth was milked for Himálaya, to be the ज्योतिष्मती or *luminous plant,* whether fabulously so called or otherwise, of which we shall have occasion to speak more particularly on the 10th stanza. But the commentators on Cálidása, both Mallinátha and Bharata-mallica ; assign that place to the fabled *Sanjívaní* whose juice can revive the dead : the latter adding also the herb *Visalya-karini,* to which the same revivifying property is ascribed in the Lanka-kandu or 6th book of the Rámáyana of Valmíki. The idea of medicinal herbs is therefore made the most prominent in my translation : though it should be added that both the above-mentioned Scholiasts apply the epithet भास्वन्ति here, viz. "*sparkling*" or "luminous," to the "*herbs,*" as well as to the "*gems.*"

The all-sustaining virtues of Mother Earth could not possibly be conveyed to a Hindu under a more dignified image than that of a cow and her dependent calves. We see the same image curiously applied to the highest mysteries of the Vedantic philosophy, in the following distich of the *Panchadasí* or Quindecad of Vidyáránya Svámí,

मायाख्यायाः कामधेनोर्वत्सौ जीवेश्वरावुभौ ।
यथेच्छं पिबतो द्वैतं तत्त्वं त्वद्वैतमेव हि ॥

i. e. "Of the cow of desire, called Má'yá (the Great Illusive Mother of Nature, of whom Satí and Parvatí are but incarnations), there are two calves,—the separate Soul, and God. Both drink abundantly as they list : (the former drinks) *duality* (or diversity), which is its essence ; (the latter,) *simple unity.*"

Compare the cow Nandiní in the *Raghu Vansa* of our author, II. 63—66, &c. &c.

3.

While gems thus unnumber'd of bountiful Earth
Encompass this favourite child from his birth,
* Ev'n hoary dull frost, on his lofty brow seen,
Takes nought from his bliss or his glory, I ween:
* One fault may well merge in a flood of such praise,
* Unmark'd, as one spot in the gentle Moon's rays.

4.

For borne on his craigs, lo what rivals the grace
* Of fairy light steps that ethereal nymphs trace,
* The glitt'ring bright rock, all in broken streaks seen
As belts of the shifting cloud gather between;
* And evermore wearing, from morn to still night,
The rich blended hues of the ev'ning twilight.

---

*St.* 3. *Ev'n hoary dull frost, &c.*—This idea of frost, as a mere blemish in the otherwise surpassing glory of the mountain, is characteristic of Hindu sentiment. Thus in a curious dialogue called *Vishva-gunádarsana,* written by an ingenious poet of the Deccan, named Venkatichári, describing the travels of two Gandharvas or celestial songsters over the world, one of whom praises, the other censures, every thing,—the praise of Badarika, the holy retreat of the sage Vyása on Himálaya, by the one, is reckoned to be sufficiently censured by the other urging the *frost,* which he declares sufficient to prevent, if not destroy the merit of every pious exercise performed there.

यत्र जागर्त्ति शिलासमं हिमं
सुशीतला गन्धवहाश्च दुःसहाः। | जलावगाहाचकिता जनास्ततः
कुतस्त्वनुस्थास्यति कर्म निर्मलं।

*Ibid. As one spot in the gentle moon's rays.*—इन्दोःकिरणेष्विवाङ्कः The propriety of this expression is disputed by some Pandits, on the ground of the spot belonging not to the *rays* but to the *body* of the moon. Of this the reader may judge according to his taste.

*St.* 4. *The glitt'ring bright rock.*—The word धातुमत्ता or *mineral,* which I have translated *rock,* is explained by Bharata-mallica to mean here simply गैरिकं or *red chalk*—by Mallinâtha, a little more generally (धातवःसिन्दूरगैरिकादयो यस्य सन्तीति धातुमान्), but still restricting the mineral or rocky strata here described to those of a red colour. Whence arises this determination of the Pandit commentators to give this special import to a word of general signification,—when the most various colouring which the word admits would both accord better with the actual appearance of the mountain, and add more grace to the author's description,—it is not easy to point out. I should be disposed to ascribe it to the comparison of evening twilight in this stanza, and the scholiasts' passion for systematizing the *loci communes* of poetry, evinced in making the evening hue exclusively red:—did I not observe the same limited interpretation elsewhere, as in v. 104 of the *Mégha Duta* of our poet—where their interpretation of

5.

* His tow'ring peaks, glowing with nearer sun's heat,
Are climb'd by the holiest devotees' feet;
Who worshipping first the huge shades, downward thrown
From clouds thickly circling the high mountain-zone,
Thence higher advancing, are chill'd in its rain
Of drenching white mist, ere the summit they gain.

6.

His snows soon effacing the marks, gory red,
Where lions, fierce slayers of elephants, tread;—

---

धातुरागाः or *colours* of the mountain rock, to be merely red, (notwithstanding the plural) is suspected by Mr. Wilson to be owing to the possible predominance of ammonite or copper ore in some of the strata of the Himálaya. I cannot however persuade myself that either in the present passage, or in that of the Cloud Messenger, Cálidása should have entertained the limited sense ascribed to him by his commentators,—since he has himself in another part of that poem (St. 60, 61, vv. 403—410 of Wilson's translation) described expressly in powerful images, though still below the truth of nature, the mingled white, blue, grey, and black, of the rocky strata of the same stupendous mountain to which his Yaxa hero was there exiled. The reader may, if he will, compare our ancient poet's description in these several places with what Mr. Fraser records in his Journal of a Tour to the Himálaya mountains (pp. 255, 317, 344, &c. &c. of the 4to. edition of 1820), respecting the intermixture of *every* diversity of hue, reflected from the variously stratified peaks. On every account, therefore, I prefer the most general meaning of the *dhátumattá* here.

*Ibid. And evermore wearing, &c.*—The meaning of these two last lines is conveyed by Cálidása in as many words, *Akála-sandhyám iva*, literally "like an evening-twilight out of its time:" but the immediately understood import of the short Sanscrit compound could scarcely be evolved intelligibly in a less compass of English words, than in the metrical paraphrase I have given.

*St.* 5, 6. My Malayalim MS. transposes these two stanzas: but the order of all the Devanágari and Bengáli MSS. and commentators, seems here decidedly preferable.

*St.* 5. *The holiest devotees.*—To the reports brought back by these holy pilgrims, (सिद्धाः or *perfect men,* as they are here called, when they attain their object,) a large portion of the strange matters popularly credited and described by our bard as belonging to this mountain, may be certainly ascribed: amongst them, the elevation above the region of frost and snow, of summits glowing with the more ardent heat of the approximated sun. See the note on St. 16.

*St.* 6. *The mountaineers, &c.*—Properly the Kira'tas: for the name, though often used to denote merely a mountain woodsman and hunter, was originally the name of a tribe or nation on the N. W. of the Indian mountains, viz. the *Kirrhadæ* (Κιῤῥαδαι) of Ptolemy, or as it has been sometimes read *Kirrhodeeis.* In the Institutes of Manu (x. 43, 44,) these are enumerated along with some tribes of an undoubtedly Hindu origin, and others as undoubtedly foreign, (the Cambojas, the

The mountaineers, skill'd in the dangerous chase,
Can still, though unseen, the destroyer's path trace ;
The frontal pearls, dropt from his claws on the way,
Point out where the monster has borne his huge prey.

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Yavanas or Greeks, the Sacæ or great Indo-Scythian nation, the Persians, Parthians, Chinese, the Daradæ, and inhabitants of Khasa-giri, or Cashgír, the Indian Caucasus,) who are said to have fallen to the lowest class from their original distinction of Xatriyas or Rajpútas, by neglecting the proper religious rites of their caste, and seeing no Brahmans.

शनकैस्तु क्रियालोपादिमाः क्षत्रियजातयः ।
वृषलत्वं गता लोके ब्राह्मणादर्शनेन च । ४३ ।
पौण्ड्रकाश्चोड्रद्रविडाः काम्बोजा यवनाः शकाः
पारदाः पह्लवाश्चीनाः किराता दरदाः खशाः । ४४ ।

The historical drama *Mudra-Ráxasa* enumerates the Kirátas together with the Sacæ, the Macedonian Greeks, the Cambojas, the Persians, and Bactrians, as having inundated from the N. W. frontier, under the conduct of Chánakya, Chandra-gupta's able and wily minister, the ancient capital of the Nanda kings ; शकयवनकिरातकाम्बोजपारशीकबाह्लीकप्रभृतिभिश्चाणक्यमतिपरिगृहीतैश्चन्द्रगुप्तपर्वतेश्वरबलैरुदधिभिरिव प्रलयकालचलितसलिलसंचयैः समन्तादुपरुद्धं कुसुमपुरं । Act II. p. 41, ed. Wils. The note of the learned translator (p. 64, of the 3rd volume of his Hindu Theatre) here well deserves to be consulted. I would only add, with reference to two statements in it, that as the name יון *Yavan* or يونان (Ιαονες), which is known to have been the common appellation of the Greeks throughout western Asia, leaves no doubt of the Yavanas here being the followers of Alexander the Great,—so there is as little reason for ascribing a vague or uncertain site to the Kirátas or Cirrhadæ. The most accurate of ancient geographers, by whom alone the name in this correct form was given to the western world, has in the 12th chapter of his 6th book, fixed with singular precision the position of these mountaineers with respect to the other Sogdian tribes, viz. on the eastern side of the Oxus, not far from its source in the Paropamisian mountains, near where their range meets that of the Indian Caucasus ; and not far from where Alexander fixed the site of the last of the cities called by his name, before he invaded India. Thus the Kirátas are north of the Bactrian tribes, and due west of the Sacæ, in the parallel of about 37° N. agreeably to what might be inferred from the Indian history preserved in the *Mudra-Ráxasa.* [The existence of a country called Cirrhadia, east of the Delta of the Ganges, the modern kingdom of Arracan, might lead to some confusion : but in the position of the *tribe* of Cirrhadæ by Ptolemy, there is no ambiguity : and his error in making the latitude of this and the circumjacent places too far north by about 4° is no impeachment of the accuracy of his *relative* description, obtained from the routes of the mercantile travellers of his day.] I will only add, that these same Kirátas seem laid down under the name of Cirabæ Indi along the Imaus range towards the north, in that curious monument of antiquity, the Peutingerian Map [Sect. vii., *a Paralocis* (परलोकेभ्यः ?) *Scythis usque ad finem Asiæ.*]

7.

On him grow the birches, all rough with flak'd bark,
Which wanton wild elephants eagerly mark,
Their huge sweating fronts rubbing o'er it amain,
Till all its peel'd folds bear the ruddy deep stain :
That bark which hereafter, in paper's smooth leaves,
From min'ral red ink the trac'd letter receives ;
Impassion'd warm lines, haply, destin'd to bear,
By Love's god indited, to deified fair.

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*St.* 6, 7. *The frontal pearls, &c. &c.*—The European reader has no need to be assured that the मुक्ताफलं or pearl, supposed here, and in numberless other Hindú writings to lie under the *kumbha* or frontal bone of the elephant, is a mere fabulous non-entity. The confidence with which book-learned Pandits will, however, assert its reality, is as surprising as it is characteristic : though some few, who have learned a little regard for experiment as a guide to truth, are cautious enough to confine its existence to the three former ages : thus making the frontal pearl (like the horse and ox sacrifice, perfect abandonment of the world, the presentation of flesh to deceased ancestors, and the levirate law), a thing too precious for the present degenerate Kali-Yuga or iron age of the world.

The same fabulous character is by no means so apparent in the *fragrant unctuous red ichor* mentioned in St. 7, as secreted in the elephant's forehead, and exuding during the rutting season. This persuasion, which not only pervades the literature of the Hindús, but has been communicated by them to inquirers of other nations, is however generally condemned by naturalists as a vulgar error ; the most diligent observers having failed to discover anything beyond common perspiration. (See Encycl. Metrop. Art. Elephant : where is also stated a singular current belief, connected with this, of some natives of Western India.) Of the antiquity of this belief we have a singular vestige in Strabo's description of India, (lib. xv. vol. 6, p. 91, ed. Siebenkees) where he states that the male elephant at that season grows furious, and " emits a sort of fat through a pore or vent which he has near the temples :" the opening of the same pore indicating the corresponding season of the female. [καίρος δ'ἐστι τῷ μεν ἄῤῥενι, ἐπειδὰν οἴκοι κατέχηται καὶ ἀγριαίνη. τότε δὴ καὶ λίπους τὶ διὰ τῆς ἀναπνοῆς ἀνίησιν ἣν ἔχει παρὰ τοὺς κρόταφους. ταὶς δε θηλείαις ὅταν ὁ αὐτὸς πόρος οὗτος ἀνεωγὼς τυγχάνη.] This information was probably delivered by the Brahmans of Chandragupta's court at Pataliputra to Seleucus's ambassador Megasthenes, who is Strabo's great authority on Indian affairs : for Aristotle, who wrote shortly before that communication with India, and has embodied all the information of his time, (refuting whatever he thought fabulous,) in his numerous books on Animals, has recorded no such particular as this of the elephant.

*Ibid.* The भूर्ज *Bhúrja* or *Mountain Birch,* (Betala Bhojapatra of Wallich,) is surrounded, like the birch tree of Europe, with a bark consisting of several layers, capable of being peeled off in ample flakes, and liable to become rough from the constant unequal peeling of its folds, though the texture of each layer or cuticle in itself is remarkably smooth : hence it is described in St. 57 of this canto as स्पर्शवती or pleasant to the touch, and thus a fit clothing for Siva's attendant gods. Though

8.

He, filling the hollows of all his brave trees
Of rattling bamboo with a whistling wild breeze,
That sounds from the covert of every deep den,
And echoes through all, over forest and glen,—
Might seem to be piping and leading along
Heaven's quire of musicians, commencing their song.

9.

His beauteous tall pines, when the elephants heal
By friction on them, the sharp twitching they feel

---

this use of clothing the immortals is as little apparent in the present day as that of corresponding with them, the bark is still extensively employed, as it was in Cálidása's time, for the fabrication of a very common kind of paper among the Hindus, as well as for the less poetical purpose of supplying what our countrymen in India call the *snakes* of their hookas. A fuller description of this tree may be seen in Dr. Wallich's very valuable work, Plantæ Asiaticæ Rariores : to whom I am also indebted for a sight of a frustum of its trunk brought by him from Nipál, and illustrating the above statement.

The use of this birch paper in bearing erotic messages to the fair Vidyádharás of Indra's heaven, which Cálidása thus oddly contrasts with the rough embrace of the wanton elephants, (the two states of the bark being singularly mixed together in the Sanscrit sentence) is curiously illustrated by the converse application, exhibited by our poet himself in his beautiful drama of *Vikrama* and *Urvasí*, or the "Hero and the Nymph :" where the celestial nymph Urvasí uses a *leaf* of the birch tree to convey her passion to a mortal prince. The leaf plucked in the forest, and hastily inscribed with a few elegant Prácrit lines, is dropped by the divine fair one in sight of the king's confident, who bears it to his master. (Act. II, p. 33 of the Sanscrit edition, p. 86 of Wilson's translation.)

*St.* 8. *He filling the hollows, &c.*—The office ascribed to the sylvan and mountain deity Pan in the Homeric hymn to that god, and in Ovid's Metamorphoses, i. v. 707, of giving the first notions of music to mankind by blowing through reeds with the winds of heaven, and even instructing the immortals in the same art, (and as the Orphic hymn pursues the idea, thus setting an example of the harmony of the heavens,—

'Ελθέ μάκαρ, σκιρτητά, περίδρομε, σύνθρονος ὥραις,
Αἰγομελές, βακχευτά, φιλένθεος, ἀντροδίαιτε,
'Αρμονίην κόσμοιο κρέκων φιλοπαίγμονι μολπῇ.

i. e. as some say, by the gamut of his syrinx answering to the seven planets,) is here ascribed to the gigantic Himálaya, with all the advantage that the far larger and more noisy reeds of the Indian forest give to the representation. Our poet has spoken elsewhere of the natural music of the bamboos, but in a more tranquil strain, and with no mention of the mountain leader of the band, or of his echoing caverns, in St. 58 of the Cloud Messenger, and in the *Raghu-vansa*, 2nd Canto, St. 12.

*St.* 9. *His beauteous tall pines, &c.*—The सरल Sarala or Pinus longifolia, sometimes called the Cheer, which is the species of pine here mentioned, is of the most

Athwart their big foreheads,—a liquor distil
Of milky white hue o'er each fir-covered hill :
Whose well diffus'd fragrance makes every dark height
And table-land, pregnant with od'rous delight.

10.

All night on his herbs as innocuous fires blaze,
The caves' inmost chambers are pierc'd by their rays :
Not trimm'd with oil they,—yet to spirits that rove
In forests, enamour'd, the true lamps of love.

---

frequent occurrence in Sanscrit poetry. It grows in abundance, as I am assured by my learned friend Dr. Wallich, in Nipal, and all the mountainous regions on the northern frontier, and contains much resinous matter, of a very fine and aromatic kind ; which might not unreasonably be supposed to flow abundantly from any wound or incision made in the tree : but as to the scratching elephants habitually performing that agreeable office, and earths and rocks reflecting the fragrance thus imparted to them ; this he thinks may well be set down to the imagination of the poet, or of those whom he is here content to follow. (Of the friction of the elephants, compare the notes on St. 6 and St. 15.)

*St.* 10. *All night on his herbs, &c.*—What is here meant by Cálidása is not, (as might be at first sight supposed) a spontaneous ignition of herbs by friction often issuing in the conflagration of forests,—a common subject of description in Indian poetry, though little accordant with the circumstances annexed to the fires in this stanza. It refers to *lambent* fires, like those described in Lucan's mysterious Druidical forest near Marseilles, (Pharsalia iii. 420).

—*non ardentis* fulgere incendia silvæ—

or those of Argolis in Seneca's Thyestes, Act. IV. (where though the terms are just opposite, the meaning is precisely the same)

Tota solet
Micare flammâ silva, et excelsæ trabes
*Ardent sine igni*—

or like those by which, in the special prodigy manifested in the commission of the Hebrew legislator at Horeb, (Exod. ii.) the plant " flames, but is not consumed." The authority given by the two commentators whom I have consulted on this poem, for enumerating this among phenomena of constant occurrence, is simply the *Ágama* or *Tantra*, the Indian Cabbala, venerated scarcely less than the *Nigama* or Vedas themselves, by the votaries of Siva and of his female energies or Sactis. The passage thus cited from the *Ágama* (without further particularity of reference) is given by Mallinátha as follows : रात्रावोषधीषु तेजो निधाय रविरस्तं याति i. e. " The sun when he has deposited his rays for the night with the deciduous herbs, goes to his setting." And thence a friendly acquaintance, endeared by occasional absences, is established between the herbs and the rays to which they are nightly attached, of which poetical fable our author makes a very elegant use in the 30th stanza of this book.

11.

His steep defiles climbing, with petrified snows
Heap'd up, shooting aches through the strain'd heels and toes,—
The dames of Heaven's horse-headed quire, in array,
To high upper regions pursue their slow way:

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Were it an ancient author of the western world who thus enumerated the cave-illuminating herbs among the wonders of Himalaya,—we should have little hesitation in referring his story to the phenomenon of the *fire-fly*, presenting to the eye of an unobservant stranger the appearance of sparks inherent in the trees or shrubs on which those insects play. But this origin can scarcely be ascribed with any probability to the existence of such a belief among the Hindus, to whom every thing regarding the खद्योत or fire-fly is most familiar: and its mention *in this manner* can only be accounted for by the disposition which characterizes them beyond all other people, not only to admit the customary occurrence of prodigies, (as more enlightened nations have been prone to do,) but to cease to consider them as such, and to class them among the most familiar objects of their daily experience.

I should add, however, that this particular belief, founded wholly on the Tantras, is one not commonly adduced in Hindu poetry: except in these instances of Cálidása's present work, and one in the *Sisupála-badha* of the poet Mágha, I am not aware of its occurrence, nor do I think it has attracted the notice of any European scholar. The *jyótismati* or *luminous plant*, which as was observed in St. 2, is mentioned by some as pre-eminent among the herbs divinely given to Himálaya, is one of the most common of Indian plants, the *heart-pea* (so called from the shape of its fruit), or *halicacabum cardiospermum:* and notwithstanding its name in Sanscrit, together with 18 others of which several are equally splendid in import, found in the Amara Cósha and other vocabularies, it has no properly luminous or blazing quality ascribed to it by any of those respectable authorities. And if we inquire concerning the most "sparkling" of Himálaya's medicinal herbs according to the scholiast on St. 2, I mean the magic *Visalya-karani*, which was sought to restore life to the slain brother of Ráma himself, we find in the Lancakánda, § 80, the monkey warrior Suséna, in his minute directions given to his chief Hanumán, (that he might recover it from the millions of Gandharvas, Raxasas, and others who jealously watched it,)—describing indeed its yellow leaves, green fruit, its red and golden flowers, &c.,—but not a word of any भास्वत् or *illuminating* property.

*Ibid.* *To spirits that rove, &c.*—The English word *spirit* will rather be understood of a superhuman being, than of the spirit of a man: and indeed I am rather anxious for an interpretation which European taste requires, in order to give dignity to a circumstance like this, when introduced in connexion with the mysterious and supernatural fires that light up the caverns of Himálaya. The truth, however, must be told in the note, whether such management in the text be excusable or not: viz. that the वनेचराः or "forest-rovers" here mentioned were doubtless, in the mind of Cálidása as well as of his Indian commentators, mere *men;* i. e. किरातादयः the Cirrhadæ and other troglodytes of these mountains.

*St.* 11. *Heaven's horse-headed quire.*—Amongst the bizarreries of Hindu mythology, is that of giving the heads of horses to the heavenly musicians, who are thence

With loins sorely wearied, and labouring breasts,
The zealous firm band yet desists not, nor rests.

12.

He, King of Hills, keeps from the Sun's killing gaze,
Close hid in his caverns' impervious deep maze,
The Genius of Darkness:—who owl-like, below,
There broods unperturbed and safe from his foe.
When th' humble man truly such refuge can find,
The high-headed patrons must be passing kind.

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called, from the surprise naturally excited by their appearance (in the same manner as the Manna that fell in the wilderness received its interrogatory name) किन्नराः or किम्पुरुषाः as if we should say in English *What-men!* The place of these *Kinnaras* in the creation is laid down by Manu 1. v. 39. See also Moor, Ward, &c.

*St.* 12. Whether Cálidása in the last two lines of this curious stanza intended a compliment to patrons, and particularly to the great monarch VICRAMADITYA, whose splendid protection of genius and merit, (perhaps indigent or oppressed by envy) he himself so largely shared, at an era preceding by a very few years that of the Roman AUGUSTUS,—or whether it is to be taken as an oblique satire on the उच्चैःशिरसः or "high-headed" patrons of humble men generally, it is not possible in the dearth of all properly historical and biographical materials, to determine with any probability. But however this may be, the word ममत्वं *mamatvam* is here undoubtedly to be taken in a simply good sense for *partial or friendly regard.* Though properly meaning regard to a thing *as my own*, agreeably to its derivation from the genitive *mama* (*quasi Latinè* MEITATEM *diceres, Græcè* EMOTHTA) —and therefore according to Hindú theological principles requiring, equally with the अहंकारः *ahankára* derived from the nominative of the same pronoun (viz. τo ΕΓΩ, or "le MOI" of Marmontel, &c.) to be extirpated from the breast of the perfectly wise man, who is to see all things in God, and to be as free from partial attachment of any kind as from gross selfishness,—yet in all but Vedantic writings, the former word is as generally used in an amiable sense, as the latter is in the reverse. Even the *Dévi-máhátmyam* of the Marcandéya Purána, intended mainly to shew how the Vaisya Samádhi at length attained eternal beatitude by expelling both these feelings from his bosom,—represents the *mamatvam* or *mamatá*, of which he required to be cured, as one of the kindliest of human sentiments,—viz. a fond attachment to, and regret for the loss of, a wife and children, who had ungratefully used and deserted him. But perhaps a more distinct idea of the application of this word and of its origin may be obtained from the following very homely distich, which I find in the metaphysical play *Prabódha-Chandródaya*, or Rise of the Moon of Intellect—(a drama intended to teach the rigid stoical doctrine above alluded to,) Act 5, Scene 2.

मार्जारभक्षिते यादृङ् ममता गृहकुक्कुटे
न तादृङ् ममता प्रीत्य कलविङ्केऽथ मूषिके

i. e. "Such kind and partial regret (*mamatá*) as is felt for a domestic fowl devoured by the cat, we feel not for a mere sparrow so killed, still less for a mouse."

13.

For him the large Yáks in his cold plains that bide
Whisk here and there, playful, their tails' bushy pride.
And evermore flapping those fans of long hair
Which borrow'd moon-beams have made splendid and fair,—
Proclaim at each stroke, (what our flapping men sing)
His title of honour "The dread Mountain-King!"

14.

On him, when their conscious self-stripping ev'n shames
The frolicsome spirits of Heaven's piping dames,
To please them, the clouds have a thick curtain made,
Which o'er the cave's mouth drops its shelt'ring broad shade.

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*St.* 13. Of the Yák or *Bos grunniens*, a description may be found in Hamilton's Hindustan, vol. ii. p. 569, in the midst of the description of Thibet,—or in any book of Natural History written subsequently to Turner's Embassy to that country. The conceit contained in these lines of Cálidása, is one which I fear will scarcely approve itself to the taste of European readers: and can only be understood by explaining 1. that of the hairy tail of this animal, called चमर *Chamar*, the Hindús make the flappers commonly used for brushing away flies and musquitoes, which are thence called in Sanscrit चामरं or चामरी but in the common Hindvi language चौंरी i. e. چونري or *chowrie*: and 2. that the waving of such a chowrie set in a golden handle over the head of a Prince or over the image of a God, is accompanied with the proclamation of his name and titles, and reckoned among the constant emblems or insignia of royalty. [A most striking example of the importance attached to this may be seen in Col. Tod's Annals and Antiquities of Rajasthan, p. 265, where an apparition of the sanguinary goddess of Chittore, (a form of our Parvati) demands twelve regal victims as the price of her continued protection of the city from the Tatar invaders of the close of the 13th century. "On each day enthrone a prince: let the kirnia, the chehtra, and the *chámra* proclaim his sovereignty, and for three days let his decrees be supreme: on the fourth let him meet his foe and his fate. Then only may I remain." The terrible history that followed the promulgation of this supernatural announcement must be fresh in the mind of every reader of that deeply interesting work.] Hence the fancy of the poet: that the grunting ox, frisking in his natural state on the high table-land of Thibet and Nipál, anticipates his fine tail's future destiny, and flaps it to proclaim the honours of his wild liege lord "Himálaya, King of mountains."

*St.* 14. The poet here returns to the female Kinnaras or heavenly musicians, whom he left in St. 11, pursuing their laborious way to the upper regions, and glad to disengage themselves of any clothing that would impede their progress. He brings them to the mountain-caverns, ever the favourite residence of heathen deities, of female deities especially;—in the words of old Hesiod, (Theogon. v. 129.)

*θεῶν χαρίεντας ἐναύλους*
*Νυμφέων αἳ ναίουσιν ἀν' οὔρεα βησσήεντα.*

The covering dropped from the clouds to hide them from view, is vindicated from every unnatural exaggeration by the following passage in p. 348 of Fraser's

15.

His wind,—whether bearing along the chill spray
Far scatter'd from where, on its snowy white way,
Down dizzy heights plunging, great Ganges' young river
Full darts its precipitous torrent for ever,—
Or shaking the fragrance of tall cedar trees,—
Or spreading the peacocks' tails out to the breeze,—
Is hail'd in its cold, sweet, or languid career,
By tir'd mountain-hunters that chase the swift deer.

---

Tour to Himâlaya. " We had projected the ascent of a snowy peak directly behind Seran; but on the day intended, the clouds *fell down* to the foot of the hills, enveloping all in the most complete and impenetrable darkness. It was not like a common mist: it was really a *sinking of the clouds* from the rarefaction of the atmosphere *till they quite shrouded us*."

*St.* 15. *Shaking the fragrance of tall* CEDAR *trees.*—So I render the word देवदारु déva-dâru, which is the *Pinus Deodaru* of Dr. Roxburgh, and which, as Dr. Wallich informs me, is very nearly allied to the cedar of Lebanon so celebrated in Western Asia. It abounds in the high regions of Nipâl and westward, but never at a less elevation than 10,000 feet above the sea: its wood is hard and durable, retaining a lasting fragrance: the turpentine extracted from it, far exceeding other kinds in scent. A full account of the tree, (though not a good drawing) is given by Mr. Lambert in his splendid work on Pines.

Cálidása in his other great mythological poem the *Raghu-vansa,* Canto ii. St. 36 and seq., tells a wonderful history of one of these Dévadáru cedars that was adopted by our goddess Párvatí, and nourished as her own daughter: and who, when lacerated by the forehead-rubbing elephants (in the manner described here, St. 7 and 8,) had a guard placed over her by Siva at the instance of his beloved Párvatí, in the person of his servant Kumbhódhara, turned for that special purpose into a fierce lion. [The whole however turns out at the end, to be but a magic scene got up by Nandiní the sage cow of Vasistha, in order to try King Dilípa's fidelity and devotion to her. See note on St. 23.]

*Ibid. Is hail'd, &c.*—In repeating here the triple character of the light breezes of Himâlaya, I follow the ideas of the Indian commentators. The " tir'd *mountain-hunters*" are the same Kirátas whom we had before in St. 6. The *salutation* of the refreshing breeze after a weary chase, as implied in the word आसेव्यते, may remind us of the invocation under the same circumstances of the hunter Cephalus, (so fatal to his jealous wife Procris. Metamorph. vii. 837).

Egredior, silvasque peto : victorque per herbas
AURA, VENI, dixi, *nostroque medere labori.*

And I should remark, that it is the same kind of *worshipful welcome* and nothing further, that is intended by the kindred word निषेव्य in St. 5—i. e. the holy devotees first " *hailing*" (not religiously adoring) and *willingly seeking* for shelter the huge shades of the mountain clouds ; which, higher up, turn to chilling rain and mist.

16.

On his crowning lake, as the lotus-flowers grow,
The seven blessed RISHIS pluck some ere they blow,
T'adorn the fifth heav'n : while the Sov'reign of day,
As circling beneath, he with upward strong ray
Peers o'er the calm waters, the rest ripes apace,
And opes to full bloom their enchanting soft grace.

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*St.* 16. *On his crowning lake.*—The word सरस or *lake* occurring only as a member of the compound epithet of the lotus flowers, might be translated with equal grammatical correctness, *lakes* in the plural. If a single lake only be intended, which the epithet अग्र or *crowning* and other circumstances, seem to make by far the most probable interpretation, it can scarcely be any other than that called in modern Hindvi language Mansarour, from the Sanscrit मानससरोवर i. e. the great lake Mánasa, situated in the centre of Himálaya, 31° N. 81° E. in an oblong basin of 15 miles by 11, inclosed by the principal range to the south, part of the Kailása range peculiarly sacred to Siva on the east, and other high mountains and table-land on the north and west: a lake frequented as a place of pre-eminent sanctity by Hindu pilgrims,—but before Mr. Moorcroft's visit scarcely known to Europeans. If however, with Mallinátha, we suppose several high-mountain lakes to be here meant, we may join with the Mánasa the lake of Ravana westward of it, whence issues the great Satadru or Sutlej river, and others: particularly such as Hindu imagination or the report of probably mendacious pilgrims has fixed on the inaccessible summit of the high peak Bunder-pooch, (वानरपुच्छ *Vánarapuch'ha*, the tail of the Monkey Hanumán.) See Asiatic Researches, vol. xiii. pp. 189, 190. What the poet however says here, or seems to say, concerning the lake Mánasa,—he has elsewhere said of the Ganges, which had been commonly, but erroneously supposed to spring from it. For thus says Ráma to Sitá in the *Raghu-vansa*, Canto xiii. St. 51, when describing the mystic forest of the sage Atri.

अत्राभिषेकाय तपोधनानां | प्रवर्त्तयामास किलानुसूया
सप्तर्षिहस्तोद्धृतहेमपद्मां। | त्रिस्रोतसं त्र्यम्बकमौलिमालां॥

"Thither, for the due ablution of sages whose wealth is austerity, has Anusúyá (the wife of Atri) turned the course of Ganges flowing through the three worlds, the diadem of the three-eyed Siva, *her whose golden lotus-flowers are plucked by the hands of the seven Rishis.*"

But the intention of Cálidása in this stanza, as his commentators truly say, is to close his description of Himálaya by a splendid instance of अतिशयोक्ति or *hyperbole*, such a one as, in the words of the rhetorical poet Dandí whom they quote, is लोकसीमातिवर्त्तिनी i. e. *transcending the limits of the worlds.*

——vivida vis animi pervicit et extra
Pervasit longe flammantia mænia mundi.

For not only does he state the highest summits, to rise above the planetary sphere, (to use the terms of the Hindu and the Ptolemaic astronomy,) so that the Sun can

17.

In him, then, the Father of Heav'n and of Earth
Beholding a nature which freely gave birth

---

only look upwards at their crowning lake,—but above the yet higher sphere of the fixed stars,—even to the highest visible celestial sphere occupied by the seven Rishis, (Maríchi, Atri, Angiras, Pulastya, Pulaha, Kratu and Vasistha,)—whose stations in the pre-eminently favoured seven stars of the Great Bear, are thence imagined by the Hindús, in despite of long astronomical observation, to retain ever the same position with respect to the poles of the earth, unaffected by the precession of the equinoxes, that changes the declination as well as the longitude and right ascension of all inferior stars. Thus the *lóka* or world to which these yet unblown flowers are transferred by the hands of the blessed Rishis is removed by two or three steps above that of Indra, Surya, and the other celestial gods, and is only below the seventh *lóka*, the abode of Brahmá : which makes it the fifth when the earth is not included. See Wilson's Dictionary, Art. लोक.

We need not wonder therefore that in the general destruction of the three lower worlds, the earth, the region of Munis, and the solar heaven, by a flood at the close of the Manvantara,—in which the pious King Vaivasvata alone was preserved in an ark, accompanied by the seven Rishis,—the highest peak of Himálaya should yet appear above these waters : and that the Rishis should be commanded by the Divine Preserver (in the shape of a fish), to fasten the ship's cable to this peak, (the Hindú Ararat,) "thence called," says Vyása, "*Naubaudhanam* or the *ship-binding* even to this day." For so we read in the *Aranya-parva* or 3rd Book of the Mahábhárata, in the episode *Matsyópákhyánam*.

अथाब्रवीत्तदा मत्स्यस्तान्ऋषीन् प्रहसन् शनैः ।
अस्मिन् हिमवतः शृङ्गे नावं बध्नीत माचिरं ॥ ४७ ॥
सा बद्धा तत्र तैस्तूर्णमृषिभिर्भरतर्षभ ।
नौर्मत्स्यस्य वचः श्रुत्वा शृङ्गे हिमवतस्तदा ॥ ४८ ॥
तच्च नौबन्धनं नाम शृङ्गं हिमवतः परं ।
ख्यातमद्यापि कौन्तेय तद्विद्धि भरतर्षभ ॥ ४९ ॥

Though M. Bopp, in his ingenious preface to the German translation of this episode (published in 12mo. under the title of *Die Sündflut*, at Berlin, in 1829,) labours to distinguish this simpler account of the flood from that translated by Sir W. Jones, in As. Res. vol. i. No. ix. from the more recent Bhagavat-Purána, the word लोकानां in the 28th verse of the former (which cannot be properly translated *geschopfe* or *leute*, "creatures or men"—instead of *welten* or "worlds"), proves this deluge at least to be no less universal than that ascribed by the Bhagavat to the close of the Manvantara : nor does this mention of the peak of Himálaya above the waters (which is not in the Bhagavat) at all oblige us to suppose a more limited flood to be intended by the older writer.

*Ibid. And opes, &c.*—The causal verb प्रबोधयति in this stanza is explained by the Scholiasts विकासयति i. e. "opens to full bloom." This meaning does not occur in vocabularies : and I therefore mention it here. (Compare St. 32).

To each sev'ral limb of the sacred oblation,
And adequate strength to the world's sustentation,—
Decreed of himself, when to all his great mind
Their portion of dues sacrificial assign'd,
That lordly HIMÁLAYA ever by right
Should claim sov'reign power o'er each mountainous height.

18.

He therefore, high ME'RU's sole worthy compeer,
To keep his proud lineage untainted and clear,—
Did thence to himself, with divine nuptial rite
The noble nymph ME'NÁ most wisely unite;
Whom, sprung from the PITRIS' pure spirit alone,
Ev'n MUNIS might honour and take for their own.

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*St.* 17. *A nature that freely gave birth To each sev'ral limb of the sacred oblation.*—These words are but the necessary expansion of a single Sanscrit compound, यज्ञाङ्गयोनित्वं which begins the stanza. The *limbs* (अङ्गानि) alluded to, are the flowers and fruits—the sacred grasses, *kusa*, *dúrva*, &c. together with the wood and all other materials required for sacrifice, which are so abundantly produced by the mountain.

*St.* 18. *He therefore, high Méru's sole worthy compeer.*—The adjustment of supremacy between Himálaya the highest of mountains in the world, and the peculiar glory of India on the one hand—and Mount Méru on the other; which apart from fable, should seem to have been the central spot of the Brahmanism that from the north invaded and subjugated the peninsula, (and which if the testimony of Strabo, Arrian, Diodorus Siculus, Pliny, Eustathius, and others may be admitted respecting the Indian tradition of ancient times,—must be placed near Nyssa in the mountains of Hyrcania or Margiana, not far from the S. E. extremity of the Caspian in northern Khorásán), seems to be rather a difficult point with Hindú mythological writers. The celebrated mystical episode of the Mahábhárata, the Bhágavad-Gíta, gives the same supremacy among mountains to each separately: for where Crishna in the 13th chapter represents himself as identified with the chief of all orders of creation, as the *Bhrigu* of Rishis, the *Sun* of A'dityas, the *Sáma-Véda* of sacred books, &c. &c. we find him v. 23, saying, मेरुः शिखरिणामहं "I am the *Méru* of craggy mountains," and in v. 25 स्थावराणां हिमालयः "the *Himálaya* of hills,"—giving, apparently for the purpose of thus honouring Himálaya, a second mention of mountains which is not allowed to any other order of beings. And we have seen in our St. 2, how elsewhere in the Mahábhárata and the Puránas, a compromise is made between the most sacred central mountain and his snowy compeer, by making the former the milker *by* whom,—the latter the calf *for* whom,—the choicest treasures of the parent Earth are extracted.

With respect to our present history, we find in the 36th, 37th, and 38th sargas of the 1st Book of the great Rámáyana, called respectively गङ्गोत्पत्तिः उमामाहात्म्यं and कुमारोत्पत्तिः i. e. the birth of Gangá, the great deeds of Umá, and the birth

19.

To this divine pair, as in fond embrace due
To conjugal union, the joyous time flew ;—
The mountain-king's bride, yet in lovely youth's bloom,
A new precious burthen conceiv'd in her womb.

20.

And soon she brought forth the hill-queen's darling pride,
MAINÁCA, who since to old Ocean allied

---

of Cumára [I. p. 343—359 of Carey and Marshman, or I. 143—147 of Schlegel], —that this point is in a manner settled by making Méru the father-in-law of Himálaya, i. e. the father of that very noble nymph Méná, and through her the progenitor of Gangá and Umá, the illustrious daughters of Himálaya, as well as of the god of war Cumára or Cárticéya, the offspring by one of them of Siva. It may seem strange that Cálidása, when about to pursue at length, and in a style of more ambitious ornament, a story that Válmikí has summed up thus briefly, should have departed so widely as it appears in his facts from an authority held so sacred. Not only does he here deny by implication Méná's origin from Méru, (who is here so distinctly mentioned with reference to Himálaya), by describing her as sprung from the *manas* or mental substance of the Dii Manes or paternal gods, (whose properties and order in the creation may be seen at length in Manú, Ch. iii. v. 192—201) : but he also in the succeeding stanzas, suppresses every mention of Gangá or Ganges as the elder sister of his heroine Umá : mentioning only in that rank of seniority, the comparatively unimportant Maináca.

Càlidása however has ample authority in the Puránas for his statement. Thus the Scholiast Mallinátha, (who explains मानसीं कन्यां here by सङ्कल्पजां i. e. "born from the mere volition" of the Dii Manes or Pitris)—cites in confirmation of St. 18, 19, 20,—the following distich from the Brahmánda-Purána—where we have the same mutual relation of the Pitris, Méná, Himálaya, and Maináca laid down, (without mention of Umá),

तेषां तु मानसी कन्या मेना नाम महागिरेः ।
पत्नी हिमवतो यस्याः पुत्रो मैनाक उच्यते ॥

and also the following from the Vishnú-Purána, making Méná daughter of the Pitris—and assigning to her a highly spiritual and contemplative character (agreeable to what we read here in St. 22) as well as to her sister Hárini.

तेभ्यः स्वधा सुता यज्ञे मेना वै हारिणीति च ।
ते उभे ब्रह्मवादिन्यौ योगिन्यौ चाप्युभे द्विज ॥

*St.* 19. This verse is omitted in my Malayalim manuscript, but its existence in every other that I have consulted, as well as the internal evidence of its style and language, bespeak its genuineness.

*St.* 20. *Maináca* surnamed Sunábha, once a *mountainous island,* is now, since this act of " Vritra's foe" or Indra [see Mahábhárata IV. § 4 entitled *Vritra-badha*] a *sunken rock* in the gulf (or rather strait) of Menár, that separates Lancá or Ceylon from the Indian continent. He is introduced by Válmíki as himself telling the story of this catastrophe : which as it belongs to a part of the Rámáyana (the 5th book or *Sundara-kánda,* 8th section or *sarga*) which has not yet

In bands of strict friendship, alone scap'd the blow
Aim'd full at each mountain by Vritra's stern foe.
Their wings were all clipt by the Thund'rer's fierce ire,
But his, the fell bolt left unscath'd and entire.

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been published at Serampore or Bonn, may be given entire, with a translation in correspondiug *Anustup* measure.

The Monkey chief Hanumán, son of Pavana or Máruta (the Indian Æolus), while springing over the strait to Lancá, is accosted from below by Maináca, begging him to alight, and partake of rest and refreshment from his hospitality. After some dialogue upon this,—Hanumán at length expresses astonishment at Maináca's condition in these words, and receives the following reply :

समुद्रस्याप्रमेयस्य महामकरसंकुले ।
किं त्वमन्तर्जले धीमन् विमूढो ब्रूहि कारणं ॥

एवमुक्तः शुभं वाक्यं सुनाभः पर्व्वतोत्तमः ।
प्रत्युवाच हनूमन्तं वाक्यज्ञं वाक्यकोविदं ॥

पक्षवन्तः पुरा शैला बभूवुः शीघ्रगामिनः ।
व्रजन्ति स्म दिशः सर्व्वा गरुडानिलरंहसः ॥

ततस्तेषु व्रजत्स्वेव देवसङ्घा महर्षयः ।
भूतानि च भयं जग्मुस्तेषां पतनशङ्कया ॥

ततः क्रुद्धः सहस्राक्षः पर्व्वतानां सहस्रशः ।
पक्षांश्चिच्छेद वज्रेण तत्र तत्र शतक्रतुः ॥

स मामुपगतः क्रुद्धो वज्रमुद्यम्य देवराट् ।
ततोऽहं सहसा क्षिप्तः पवनेन महात्मना ॥

अस्मिन् लवणतोये च प्रक्षिप्तो वानरर्षभ ।
गुप्तपक्षः समर्थश्च तव पित्राभिरक्षितः ॥

Hanuma'n.—In Ocean's boundless waste, o'erspread
With huge sea-monsters crowding nigh,
Why hid'st thou thus thy wave-merg'd head ?
Tell me, sage Mountain, tell me why.

Maina'ca.—Erst, mighty chief, on wings forth flew,
Free through all space, the Mountain bands,
Swift as the bird that bears Vishnu,
Or heaven's loud blast that scours the lands.

But as they soar'd aloft, strange fears
Did Rishis, gods and men surprise,
Dreading their fall ; and heaven's King rears
His bolt,—fierce lord of thousand eyes.

Then fell from thousand hills' sides low
The wings by vivid lightnings cleft.
But me, while yet the bolt-arm'd foe
Drew nigh,—unnerv'd, of hope bereft,—

21.

Next Siva's late consort, pure Satí once nam'd,
Who, towards her lov'd Lord with devotion inflam'd,

---

Thy pitying sire beheld : then straight
In his strong windy grasp he bore
Down to this briny depth, where fate
Threatens these shelter'd wings no more.

Here what is represented by Cálidása as the friendly act of Ocean, hiding the mountain under its waters,—is made by Válmíki the act of the God of Wind, hurrying the winged rock to the protecting depth,—and is therefore the subject of grateful acknowledgment to the Wind's son.

This catastrophe, (which may be perhaps paralleled in Northern mythology by Thor aiming his vengeful hammer at the Giants of the Mountains in mid-air, as told in the Edda of Snorro, Fab. 11,) is not unfrequently alluded to in the legends of the Hindús. Thus in the Kásí-kánda of the Skanda-Purána there is a soliloquy of the great mountain Vindhya, full of schemes of envy and ill-will against Méru, but suddenly recollecting and deploring his impotence to execute them when deprived of wings ; and bitterly regretting the wanton petulance of some one of his race of old that had provoked the Thunderer to this act of severe vengeance.

शक्रं कोपयता पूर्व्वमस्मद्गोत्रेण केनचित् ।
पक्षहीनः कृतो यत्र धिगपक्षस्य चेष्टितं ॥

*St.* 21. The voluntary burning of Satí, (whose name is here twice repeated सती सती, once as an epithet "*pure*" or "virtuous," and again as the proper name,) is among the best known and most constantly repeated tales of Hindú mythology ; and it is in memory of this that every self-devoted and self-immolating wife obtains the same sacred name of *Satí*, i. e. in another spelling of that very common but often mis-applied term, is a *Suttee.* The case of the prototype differs materially, as we may here observe, from the posthumous devotion of her inuumerable imitators : the affront which she thus heroically resented was offered to her undying lord, Siva, by Daxa, son of Brahmá, in omitting his distinguished son-in-law from an invitation to a grand sacrificial feast, at which all the other deities were to be present. The daughter went, though unasked : but finding only a confirmed continuance of the slight offered to her beloved husband, she threw herself into the flame and thus spoiled the sacrifice : upon which Siva, who had been comparatively indifferent to the preceding affront, avenged her death in the terrible form of Víra-Bhadra,—beheading his father-in-law (who was afterwards resuscitated with the head of a goat substituted for his own), and dispersing his guests : and the several places to which the limbs of Satí were dispersed, in his dance of mingled triumph and lamentation, obtained an equal sanctity, and were honoured with the same phallic symbol, as were those which received the several mangled remains of the Egyptian Osiris by the piety of his wife Isis. (Of these places called पीठस्थानानि, which are 51 in number, and held in peculiar veneration by the votaries of the Saktis, one distinguished one is at Cáli-ghát in the neighbourhood of this capital, which received the goddess's *fingers*).

Had giv'n her whole body a prey to the fire,
In wrath at affronts from old Daxa her sire,—
A new mother found for her birth to fresh life
In this beauteous Mе́ná, the mountain-king's wife.

---

The freedom with which the self-disembodied Satí chooses parents for a new birth to fresh life, (inferior indeed in station to the former one, inasmuch as Pitris, gods, and Munis, yield in dignity to the ten *Brahmádicás*, of whom Daxa was one, i. e. the next after Brahmá, and his sacred Triad,)—is all in accordance with the doctrine of the Indian metempsychosis, which compares this change to the shifting of garments. So the Bhagavad-Gítá, II. 22.

| | |
|---|---|
| वासांसि जीर्णानि यथा विहाय | तथा शरीराणि विहाय जीर्णान् |
| नवानि गृह्णाति नरोऽपराणि । | अन्यानि संयाति नवानि देही ॥ |

To which may be compared a statement of similar liberty in Plato's Phædrus (vol. x. p. 326. ed. Bipont.)

Though Satí daughter of Daxa, is the first birth of the goddess *Sivá*, (or wife of Siva) a name which therefore equally designates Satí and Párvatí or Umá,—we are not to consider this as the first emanation of the all-powerful energy so personified. As Mahá-Máyá, or Prakriti, or Ambicá, the Great Mother, the principle of all nature, and variable or transitory existence,—she is Dévî or *the Goddess* by way of eminence, and holds a place in Hindú theology coeval with, and in some sort superior to, the Triad itself, Brahmá, Vishnu, Siva,—the triple form which the before quiescent and inactive deity (the neuter *brahma* or *numen)* assumed respectively for the Production, Support, and Destruction of the world. This characteristic feature of Gentile theology is detailed by Marcandéya, in that singular episode called the Dévî Máhâtmyam, or exploits of this wondrous goddess—where, in the first chapter, she is described by the Rishi Médhas as lulling Vishnu the preserver into a deep sleep, by which the world's creator, Brahmá, is threatened with destruction: who accordingly invokes the goddess as विश्वेश्वरी, or lady of the universe, and superior to himself, Vishnu and Siva,—beseeching her, that she would leave his preserver to awake and destroy the invading demons. In the next chapter we have the same goddess springing into more visible existence from the united splendours and energies of all the celestial deities, when expelled from heaven by the demon Mahisha,—on which occasion Himálaya among the rest presented her with jewels and with her attendant lion: thus armed as the terrible Durgá, she destroys Mahisha, and receives the homage of all the immortals. Her incarnation in the beautiful form of Gâurí, Sivá, or Párvatí the nymph of Himálaya (from which she emerges in another form, to encounter the demons Sumbha and Nisumbha), is said in the 4th and 5th chapters, to be subsequent to this, as well as several other more terrible incarnations, which she specifies herself, (after her exploits as Cálí and concentrator of the energies of all the gods,) in the 11th chapter. But it is remarkable that in neither place where the birth of Párvatí is mentioned in that book, (IV. 33—35, and V. 40—43) is any allusion made to her preceding birth from Daxa as Satí : and the same omission is equally observable in the chapters respecting Umá in the 1st Book of the Rámáyana.

22.

Of her, then immers'd in devotion's thoughts deep,
Begot by the monarch of ev'ry high steep,—
Did SIVA's lost love once again upon earth
Derive from new parents a fortunate birth.
Ev'n thus, in the womb of *Morality* pure,
'Midst earth's turbid toil still unshaken and sure,
By strong *Perseverance*'s virtue, I wot,
The infant *Prosperity*'s ever begot.

23.

For blest was that birth-day,—its sky beaming fair ;
No cloud of earth's dust ever soil'd its pure air :
Loud conchs' swelling blast, follow'd close by sweet flowers
Rain'd down from glad skies, usher'd in its gay hours :
And moving or fix'd, ev'ry bodily thing
Partook the loud joy of the great mountain-king.

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*St.* 22. The comparison of sensible to intellectual objects, though very rarely (and as some opponents of the Ossianic poems contend, *never*) occurring in the poetry of the rude and heroic ages of the world, is not uncommon in that of a more cultivated and reflecting state of society ; and in a people so metaphysical in the cast of their minds as the Hindús might be expected more frequently than in others. A very curious instance of this inverted species of simile occurs in our author's *Raghu-vansa,* Canto xiii. St. 60—where the subject matter of comparison is the plucking of the lotus flowers from the parent lake of the Saryú river by the hands of the female Yaxa deities (resembling what was described in St. 16 of this book) —and where this sensible object is illustrated by one which can only be understood by those who have entered into the intricacies of the Sánkhya metaphysical philosophy. The latter half of this stanza is another remarkable instance of the same kind of comparison, as it is also of Indian *allegory.* NITI (fem.) or *morality,* might more exactly, as to etymology, and almost equally well as to meaning, be rendered *conduct.* UTSÁHA (masc.), which in the original as well as in the translation, is linked with the word guna, quality or virtue,—means *strenuous and persevering exertion.* SAMPAT (fem.) is *wealth, affluence* or *prosperity.*

*St.* 23. The falling of a shower of flowers from heaven is a token of the pleasure and approbation of the celestial gods. Thus, in the *Raghu-vansa* of our author, II. 60, when the pious king Dilípa offered to devote his own life instead of that of the cow Nandiní to Siva's lion before mentioned that guarded the sacred cedar of Párvatí,—and his offer was accepted by the hungry wild beast,—his deliverance from expected death, and the breaking of the spell by the immortals that applauded his fidelity, was preceded by that sign.

| | |
|---|---|
| तस्मिन्क्षणे पालयितुः प्रजानाम् | अवाङ्मुखस्योपरि पुष्पवृष्टिः |
| उत्पश्यतः सिंहनिपातमुग्रं । | पपात विद्याधरहस्तमुक्ता ॥ |

24.

And gloriously well, with a daughter so bright
As seem'd a new orb of pure orient light,
Did she, the fair mother, herself doubly shine:
So glows with fresh splendours Vidu'ra's fam'd mine;
When, cleft by electric new clouds' starting sound,
Its thunder-struck jewels dart out from their ground.

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"At this instant, over the protector of his subjects" (ποιμένα λαῶν in Sanscrit) "as with face averted, he expected the dreadful spring of the lion—a shower of flowers fell, sent forth from the hands of the celestial *Vidyádharas.*" [This approbation ended in the sacred cow permitting herself to be milked by the king in a leafy pail of that which he most desired,—the gift of *offspring* to perpetuate the race of Raghú, from which the great Ráma was to spring. Compare St. 2, suprà.]

*Ibid.* The mountain-*king* is not mentioned in the original of this stanza. But the Sthavárás or *fixed* beings peculiarly denoting *mountains*, their sympathy with their king's joy seemed a proper addition to the mention of their own.

*St.* 24. *Did she, the fair mother.* Some copies, and those not uncommon in Bengal and Hindústan, instead of सवित्री or *mother*, have धरित्री *the earth:* thus instead of the lovely Méná, making the universal mother Earth to shine by so beautiful an occupant. A meaning which beside being insipid in itself, utterly destroys the spirit of the comparison that follows. The commentaries of Mallinátha and Bharata-Mallica prove that they both read Savitrí.

*Ibid.* Vidu'ra, the Sanscrit for "remote," is also the proper name of a mountain said to produce the *lapis lazuli*, which is thence called बिदूरजं and बैदूर्य्यं. The curious native treatise on various subjects of natural history, called *Calpayukti,*—opens its account of the *parixa* or test of this precious stone, by the following extraordinary lines, which fully illustrate the meaning of Cálidása here.

कल्पान्तकालक्षुभिताम्बुराशेर् | वैदूर्य्यमुत्पन्नमनेकवर्णं
निर्ह्रादतुल्याद्दितिजस्य नादात् | शोभाभिरामद्युतिवर्णवीजं ॥
अविदूरे विदूरस्य गिरेरुत्तुङ्गदेशतः ।
कालबद्धकसीमा च मणेस्तस्याकरोऽभवत् ॥
तस्य नादसमुत्यत्वादाकरः स महागुणः ।
अभवत्त्वरितो लोके लोकत्रयविभूषणः ॥
तस्यैव दानवपतेर्निनदानुरूप
प्राहट्पयोधररवार्जितचारुरूपाः ।
वैदूर्यरत्नमणयो विविधावभासास्
तस्मात् स्फुलिङ्गनिवहप्रतिभा बभूवुः ॥

"From a cry of the giant son of Diti, resembling the roaring of the troubled ocean at the close of the Calpa, sprung the variegated *vaidúryam* (lapis lazuli); source of colours of a bright and ravishing splendour. Not far from the declivity of Mount *Vidúra*, was the mine of that precious stone, but limited to particular seasons for its production, and then closed. First from the origination of that demon cry, did this mine suddenly spring in the world,

25.

As first, a thin streak of soft silvery light,
The gleaming new moon in the West meets our sight,

---

eminent in its properties, the ornament of the three worlds : but ever since, on the muttering of the clouds of the rainy months (July and August), imitating the sound of that prince of demons, are those beautiful *vaidúrya* gems emitted, of varied lustre, and rapid effulgence as of a multitude of fiery sparks."

Mallinátha cites the second sloka of the above description, as from an anonymous *budha* or sage, to point out the mount Vidúra here meant by Cálidása : but the other Scholiast, Bharata-Mallica, erroneously explains Vidúra here as *prabálótpattisthánam*, i. e. a place where coral is produced,—a sense unknown to Sanscrit vocabularies. Except for the substitution of *coral* for *lapis lazuli*, he coincides with the above quotation—citing for the extraordinary phenomenon here mentioned the same Cabalistic authority from which we have the blazing herbs of St. 10 and 30 ; प्राहृड्घनगर्जनात् प्रबालरत्नशलाकाः पृथिव्यामाविर्भवन्तीत्यागमः " From the muttering of the clouds in the rainy months (July and August), darts of coral gems make their appearance on the earth. So says the A'gama (or Tantra)."

The situation of VIDU'RA, if we may trust the Scholiast on the following parallel passage from the 12th canto of the *Naishadha* of Srí Harsha, is identified with that of mount *Rôhana* or Adam's Peak in Ceylon. Among the many unsuccessful suitors of the beautiful Damayantí in that canto, is a Malabar prince of great riches and liberality, whom the goddess Sarasvatí thus recommends to the fair virgin's acceptance :—

अनेन राज्ञार्थिषु दुर्भगीकृतो
भवन् घनध्वानजरत्नपीवरः ।
तथा विदूराद्रिरदूरतां गमी
यथा स गामी तव केलिशैलतां ॥

" Mount *Vidúra*, abundant in gems that spring forth at the sound of thunder-clouds, yet becoming unacceptable to the beggars (that before flocked to it) through this more munificent king,—shall, however remote as its name indicates, become so near (if you accept this Southern monarch) that it shall be to you as a pleasure mount." As the Scholia referred to illustrate the words of Cálidása before us, as well as those of Srí Harsha, they may be added for the satisfaction of the Sanscrit student.

एतद्वरणीशेऽतिप्रसिद्धो विशेषेण दूरोऽद्रिरथच रोहणाचलस्तथा तेन प्रकारेण अदूरतां सामीप्यं गमी गन्ता यथा येन प्रकारेण नवकेलिशैलतां क्रीडापर्वतत्वं गामी गमिष्यति किंभूतोऽतिवदान्येन राज्ञार्थिषु याचकेषु विषये दुर्गभीकृत उपेक्षाविषयीभूतामयाचनीयतां प्रापितः अतएव व्ययाभावान्नवा घना मेघास्तेषां ध्वानः शब्दस्तस्माज्जातैरत्नैःपीवरः परिपुष्टो भवन् विदूराद्रौ हि नवमेघशब्दाद्रत्नशलाका उत्पद्यन्ते तास्च याचकैर्नीयन्ते अस्मिंस्तु बहुप्रदे सति याचकस्यागमनाद्व्ययाभावाद्रत्नैः कृत्वा त्वदुपवनं त्वं यावन्मेदुरा भवसि स एव रत्नमयत्वात्तव क्रीडापर्वतस्थाने भविष्यति अति वदान्योऽयमिति भावः ।

*St.* 25. *As daily new digits, &c.*—The कला or Indian digit, is not as with European astronomers, $\frac{1}{12}$ of the diameter of the Moon's disc, but $\frac{1}{16}$ only.

So she, the sweet infant, appear'd: but full soon,—
As daily new digits annex'd to the moon
Give birth to new phases,—so she, day by day,
Grew still to fresh forms of more lovely array.

26.

Her, dear to her kindred, the relatives all,
As mountain king's daughter, did Párvatí' call:
But after, when bent upon mortification
Most strict and religious, the fond deprecation
Burst forth from her mother, "Oh no!"—thence it came
That Um'a, "Oh no!" was the lovely girl's name,

---

There is therefore the accession of one of these for every *Tithi* or lunar day of the *suxla-paxa*, or waxing moon.

*St.* 26. Pa'rvati'.—This feminine noun पार्व्वती is the regular patronymic derivative from पर्व्वत *parvatas* or "mountain." The ascription of these two names, Parvati' and Uma', to the goddess in her second birth, is related at length in the Siva Purána, 2nd part (or *uttara-khanda*), 13th chapter.

*Ibid. When bent upon mortification, &c.*—The same is told of Umá (as distinguished from her elder sister Gangá), by Válmíki, Rámáyana, I. cap. 37, St. 19. —(Vol. i. p. 148, ed. Schlegel.)

*Ibid. That* U-ma' "Oh no!" &c.—The latter Sanscrit particle मा *má* is (like its cognate *me*, مه or مَه in Persic, μη in Greek) the dehortative "no," commonly prefixed to the imperative or optative mood; as न *na* (the same with the Persic, Latin, and Teutonic particle) is the simple negative "no" or "not," prefixed to the indicative. The former particle उ *U*, which is chiefly for want of an equivalent short word in English, rendered "Oh"—is one that is scarcely or ever seen in the ordinary classical language, though of very frequent occurrence in the older dialect of the Védas. There it may be found often annexed as if it were a termination to the several cases of the demonstrative pronoun तत्, or to prepositions in composition, when in that ancient Sanscrit (as in Greek and in German, though the *tmesis* is not admissible in common Sanscrit), they are separated from their verbs* ; and not unfrequently annexed separately to verbs or to nouns, preceding or following :—in all these cases apparently bearing a meaning *intensive* of the word to which it is annexed,—viz. (that which so often belongs to the common एव) "*precisely*" or "*merely.*" Thus we find it in the following verses from the *I'sá-vásya* Upanisad, which is the closing 40th chapter of the great Sanhitá of the Yajur Ve'da, the Vája-Sanéya-Sanhitá of Dadichi Muni, which I quote also as apposite to the subject of this stanza, to shew how the balance is carefully struck between the active and contemplative duties, in this most venerable and ancient authority of Hindú religion (vv. 12, 13, 14, but in some copies 9, 10, 11).

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* It is not therefore with perfect accuracy, that the learned F. Rosen, in his Specimen of the Rig-Veda, published at London in 1830, p. 6, describes *udu* for *ut*, and *abhúdu* for *abhút*, as mere *variations* or *licenses* of the most ancient language. They are rather the annexations to the universal form of this expressive particle *U.*

27.

Though blest with a son, not on him did the sight
Of th' earth-bearing hill-monarch dwell with delight:
For thus in the genial spring season, when flowers
All various invite from its numberless bowers,
The swarm of fond bees will there only, where grows
The sweet mango-blossom, with pleasure repose.

---

अन्धं तमः प्रविशन्ति ये अविद्यामुपासते
ततो भूय इव ते तमो य उ विद्यायां रताः । १२ ॥
अन्यदेवाहुर्विद्याया अन्यदेवाहुर्विद्यायाः
इति शुश्रुम धीराणां ये नस्तद्विचचक्षिरे ॥ १३ ॥
विद्यां चाविद्यां च यस्तद्वेदोभयं सह
अविद्यया मृत्युं तीर्त्वा विद्ययामृतमश्नुते ॥ १४ ॥

Blind darkness do they incur, who cherish ignorance (i. e. action without contemplation).
But greater darkness, as it were, than this do they incur, who delight in knowledge *merely* [उ].
For one thing, they say, is gained by (contemplative) knowledge, another by ignorance (or action).
Thus have we heard from wise men, who have so instructed us:
He who knows how to pursue both, *knowledge* and *ignorance* (thus defined) together,
Having by *ignorance* passed over death, by *knowledge* obtains immortality.

*St.* 27. The attachment of bees to the blossom of the mango, in Sanscrit चूत or अमृत (*Chúta* or *Amrita*) is one of the common-places of Hindú poetry. See the songs of Jayadéva, as translated by Sir W. Jones, Works, vol. iv. p. 242, (8vo. edition). But a more elegant example of this cannot be found than what is furnished by Cálidása himself in the 5th Act of his justly celebrated drama, the Sakuntalá, where the following song from behind the scenes reminds King Dushmanta of his inconstancy to his first attachment.

| Prácrit text. | Or in Sanscrit. |
|---|---|
| अहिणअ महुलोहभावुओ | *Abhinava-madhu-lóbha-bhávukas* |
| तुह परिचुम्बिअ चूअमंजरीं | *Tava parichumbita-chúta-manjarím* |
| कमलरसदिमेत्तनिव्वुदो | *Kamala-rasátimátra-nirvritó,* |
| महुअर विम्हरिसेसि णं कहं | *Madhukara! vismarishyasi nanu katham?* |

i. e. word for word.
In-novi-mellis-cupidinem-conversus,
Tui osculum-olim-expertum-Mangiferæ-surculum
Loti-sapore-nimium-occupatus
O mellifer! oblivisceris sane quomodo?

28.

As lamps by their radiant crest of sharp flame,—
As heaven's path by Ganges, of far-flowing fame,—
As scholars by th' eloquent charm of pure speech,—
Their last and best forms of accomplishment reach;
So he by this daughter, the crown of his race,
Was cleans'd from all stain and adorn'd with all grace.

---

"How shouldst thou, O bee, turning to the desire of new honey, and occupied too entirely with the lotus's sweetness, forget the mango blossom which thou hast so often kissed?" A comparison with this text will shew that M. de Chézy's version of this, "*Se pourrait-il, abeille volage, &c.*" in p. 102 of his very splendid and valuable edition of the "Sacountala"—though somewhat paraphrastic, has greatly the advantage in point of correctness over that of Sir W. Jones—"*Sweet bee,* &c." (Works, ix. p. 464,) which is marred by the misplacing of a very significant clause. But M. de Chézy is utterly mistaken as to the metrical harmony of this exquisite stanza, which he supposes (in p. 227 of the notes) to be in the A'ryá measure of the kind called *Gíti,* (but *Udgáthá* in the Pingala,)—in order to which he is obliged to suppose a new license, inadmissible in that metre,—and has also, in this imagination, allowed a very faulty reading बिसुमरिसेसि for विस्मरिसेसि in the fourth line. The uniform succession of long and short syllables in these lines is sufficient to shew that they are not A'ryá lines of any kind. They are of a very common metre of alternate 10 and 11 syllables, called *Aparavaktram;* the distribution of which is, { 1 and 3. Proceleusm. Anapæst. Dijamb. 2 and 4. Proceleusm. Choriamb. Dijamb.

*St.* 28. *Of far flowing fame.*—In the original त्रिमार्गया i. e. "the triple-pathed," or "whose course is through the three worlds." See Amara Cosha, II. § 3. sl. 31, (p. 69. ed. Colebrooke). The question is put and answered in the Rámáyana, I. 37. St. 3.

त्रीन् पथो हेतुना केन प्लावयेल्लोकपावनी ।
त्रिषु लोकेषु धर्मज्ञ कर्म्मभिः कैः समन्विता ॥

"Why does Ganges, purifier of the worlds, flow in three courses—and by what works, O thou who knowest righteousness, is she attended, (i. e. for what is the accompaniment of her purifying water required,) throughout the three worlds?"

No other topic of this remarkable triple comparison requires illustration, except that by संस्कारवत्यागिरा in the third, is meant the utmost perfection and correctness of *Sanscrit* speech.

[*To be concluded in the September number.*]

# उमोत्पत्तिः

अस्त्युत्तरस्यां दिशि देवतात्मा
हिमालयो नाम नगाधिराजः ।
पूर्व्वापरौ तोयनिधी*विगाह्य
स्थितः पृथिव्या इव मानदण्डः ।१।

यं सर्व्वशैलाः परिकल्प्य वत्सं
मेरौ स्थिते दोग्धरि दोहदक्षे ।
भास्वन्ति रत्नानि महौषधीश्च
पृथूपदिष्टां दुदुहुर्धरित्रीं ॥२॥

अनन्तरत्नप्रभवस्य यस्य
हिमं न सौभाग्यविलोपि जातं ।
एको हि दोषो गुणसन्निपाते
निमज्जतीन्दोः किरणेष्विवाङ्कः ।३।

यश्चाप्सरोविभ्रममण्डनानां ।
सम्पादयित्रीं शिखरैर्बिभर्त्ति ।
बलाहकच्छेदविभक्तरागाम्
अकालसन्ध्यामिव धातुमत्तां ॥ ४ ॥

†आमेखलं संचरतां घनानां
छायामधः‡ सानुगतां निषेव्य ।
उद्वेजिता वृष्टिभिराश्रयन्ते
शृङ्गाणि यस्यातपवन्ति सिद्धाः ॥ ५ ॥

पदं तुषारस्रुतिधौतरक्तं
यस्मिन्नदृष्ट्वापि हतद्विपानां ।
विदन्ति मार्गं नखरन्ध्रमुक्तैर्
मुक्ताफलैः केशरिणां किराताः ॥ ६ ॥

न्यस्ताक्षरा धातुरसेन यत्र
भूर्जत्वचः कुञ्जरबिन्दुशोणाः ।
व्रजन्ति विद्याधरसुन्दरीणाम्
अनङ्गलेखक्रिययोपयोगं ॥ ७ ॥

यः पूरयन्कीचकरन्ध्रभागान्
दरीमुखोत्थेन समीरणेन ।
उद्गास्यतामिच्छति किन्नराणां
तानप्रदायित्वमिवोपगन्तुं ॥ ८ ॥

कपोलकण्डूं§ करिभिर्विनेतुं
विघट्टितानां सरलद्रुमाणां ।
यत्र स्रुतक्षीरतया प्रसूतः
सानूनि गन्धः सुरभीकरोति ॥ ९ ॥

वनेचराणां वनितासखानां
दरीगृहोत्सङ्गनिषक्तभासः ।
भवन्ति यत्रौषधयो रजन्याम्
अतैलपूराः सुरतप्रदीपाः ॥ १० ॥

उद्वेजयत्यङ्गुलिपार्ष्णिभागान्
मार्गे शिलीभूतहिमेऽपि यत्र ।
न दुर्व्वहश्रोणिपयोधरार्त्ता
भिन्दन्ति मन्दां गतिमश्वमुख्यः ॥ ११ ॥

दिवाकराद्रक्षति यो गुहासु
लीनं दिवाभीतमिवान्धकारं ।
क्षुद्रेऽपि नूनं शरणं प्रपन्ने
ममत्वमुच्चैःशिरसामतीव ॥ १२ ॥

लाङ्गूलविक्षेपविसर्पिशोभैर्
इतस्ततश्चन्द्रमरीचिगौरैः ।
यस्यार्थयुक्तं गिरिराजशब्दं
कुर्व्वन्ति बालव्यजनैश्चमर्य्यः ॥ १३ ॥

यत्रांशुकाक्षेपविलज्जितानां
यदृच्छया किम्पुरुषाङ्गनानां ।
दरीगृहद्वारविलम्बिबिम्बास्
तिरस्करिण्यो जलदा भवन्ति ॥ १४ ॥

* Some Malayalim MSS. have वारिनिधी.
† One Malabar MS. places this sloka after the next following.
‡ Some Bengal MSS. have छायामिषे.
§ Some MSS. have कपोलकण्डूः in the plural.

भागीरथीनिर्झरसीकराणां
वोढा मुहुःकम्पितदेवदारुः ।
यद्वायुरन्विष्टमृगैः किरातैर्
आसेव्यते भिन्नशिखण्डिवर्हः ॥ १५ ॥

सप्तर्षिहस्तावचितावशेषाण्य्
अधो विवस्वान्परिवर्त्तमानः ।
पद्मानि यस्याग्रसरोरुहाणि
प्रबोधयत्यूर्द्धमुखैर्मयूखैः ॥ १६ ॥

यज्ञाङ्गयोनित्वमवेक्ष्य यस्य
सारं धरित्रीधरणक्षमं च ।
प्रजापतिः कल्पितयज्ञभागं
शैलाधिपत्यं स्वयमन्वतिष्ठत् ॥ १७ ॥

स मानसीं मेरुसखः पितॄणां
कन्यां कुलस्य स्थितये स्थितिज्ञः ।
मेनां मुनीनामपि माननीयाम्
आत्मानुरूपां विधिनोपयेमे ॥ १८ ॥

*कालक्रमेणाथ तयोः प्रवृत्ते
स्वरूपयोग्ये सुरतप्रसङ्गे ।
मनोरमं यौवनमुद्वहन्त्या
गर्भोऽभवद्भूधरराजपत्न्याः ॥ १९ ॥

असूत सा नागवधूपभोग्यं
मैनाकमम्भोनिधिबद्धसख्यं ।
क्रुद्धेऽपि पक्षच्छिदि वृत्रशत्राव्
अवेदनाज्ञं कुलिशक्षतानां ॥ २० ॥

अथापमानेन पितुः प्रयुक्ता
दक्षस्य कन्या भवपूर्व्वपत्नी ।
सती सती योगविसृष्टदेहा
तां जन्मने शैलवधूं प्रपेदे ॥ २१ ॥

सा भूधराणामधिपेन तस्यां
समाधिमत्यामुदपादि भव्या ।
सम्यक् प्रयोगादपरिक्षतायां
नीताविवोत्साहगुणेन सम्पत् ॥ २२ ॥

प्रसन्नदिक् पांशुविविक्तवातं
शङ्खस्वनानन्तरपुष्पवृष्टि ।
शरीरिणां स्थावरजङ्गमानां
सुखाय तज्जन्मदिनं बभूव ॥ २३ ॥

तया दुहित्रा सुतरां सवित्री †
स्फुरत्प्रभामण्डलया चकासे ।
विदूरभूमिर्नवमेघशब्दाद् ‡
उद्भिन्नया रत्नशलाकयेव ॥ २४ ॥

दिने दिने सा परिवर्द्धमाना
लब्धोदया चान्द्रमसीव लेखा । §
पुपोष लावण्यमयान् विशेषान्
ज्योत्स्नान्तराणीव कलान्तराणि ॥ २५ ॥

तां पार्व्वतीत्याभिजनेन नाम्ना
बन्धुप्रियां बन्धुजनो जुहाव ।
उमेति मात्रा तपसो ‖ निषिद्धा
पश्चादुमाख्यां सुमुखी जगाम ॥ २६ ॥

महीभृतः पुत्रवतोऽपि दृष्टिस्
तस्मिन्नपत्ये न जगाम तृप्तिं ।
अनन्तपुष्पस्य मधोर्हि चूते
द्विरेफमाला ⸸ सविशेषसङ्गा ॥ २७ ॥

प्रभामहत्या शिखयेव दीपस्
त्रिमार्गयेव त्रिदिवस्य मार्गः ।
संस्कारवत्येव गिरा मनीषी
तया स पूतश्च विभूषितश्च ॥ २८ ॥

* This sloka is omitted in a Malayalim MS.

† Several MSS. have here धरित्री for सवित्री.

‡ Some MSS. have नादात् for शब्दात्.

§ Some MSS. have रेखा.

‖ Some MSS. have तपसे.

⸸ Some MSS. adding *Visarga* in these two places, make the whole plural द्विरेफमालाः सविशेषसङ्गाः

## II.—*Description of the Pan-chakí or Native Water-mill.*

On the mountain streams and rivers in the Northern *Doáb,* the Natives use a water-mill for grinding corn, which for its simplicity is well deserving attention, as it might be applied in all countries, where a fall of water can be commanded, and where a want of efficient workmen renders the complicated and expensive species of mill machinery, generally used, a matter of difficulty to manage or keep in repair. In the hands of the Natives and with the rude means that they have by them, it may be perhaps considered the only sort of mill that could be turned to any account, both from the absence of any complication in its parts, and from the simplicity of its construction, rendering it in any man's power for a trifling outlay, either to fix his mill at any point that may suit him, or to remove it at pleasure; the only weighty parts about it being the mill-stones, which however by running a stick through them, and yoking a bullock or pair of bullocks to them, may in the neighbourhood of roads or common tracks be also removed with as little difficulty or expense as the rest of the machinery.

A horizontal water-wheel with floats placed obliquely so as to receive a stream of water from a shoot or funnel, the said float-boards being fixed in a vertical axle passing through the lower mill-stone, and held to the upper one by a short iron bar at right angles, causing it to revolve with the water-wheel;—the axle itself having a pivot working on a piece of the hardest stone that can be procured from the shingle near at hand:—this with a thatched roof over it, and the expense and trouble of digging a cut so as to take advantage of a fall of water,—are the only articles required in this very simple mill. The plan is so obviously good, not only for the means gained, but also from the simplicity rendering the whole almost independent of repair, and so intelligible in its parts as to come within the comprehension of the simplest understanding, that it has been adopted generally in all the canals in the Delhi district, as well as in those of the *Doáb;* and with such success, that the introduction of such mills, wherever sufficient fall is provided, is as much an object, on account of the profit arising to the canal returns, as from the accommodation and convenience offered to the community, in providing the means for grinding corn.

On reference to the accompanying plate, it will be seen that there is only one motion, and that supposing the materials are good, the permanency of the machinery depends entirely on the lower pivot. It will also be evident that there is not a part of the whole machinery that could not be repaired and put in perfect order by the commonest village workman, a matter of importance in the absence of mechanical skill and practised workmen. Whereas in the plainest undershot wheel applied to a mill for grinding corn, there are no less than three wheels of different descriptions; the change of vertical to horizontal motion;—and three pivots to keep in order, with a friction, even under the most skilful management, tending constantly to disarrange the parts, and render the accompaniments of a forge and blacksmith's shop absolutely necessary to keep the mill in order.

On the canals it has been found worth while to construct permanent buildings for these corn mills*, and although keeping most strictly to the original simplicity of the machinery, they are set up with greater care, and means are given for regulating the motion, &c. which renders the whole as perfect as it can well be.

It would appear that a fall of water (that is to say, the difference of level between the surface of the head supply and the float-boards of the water wheel), equal to three feet, is the minimum in which this species of machinery can be used with any good effect; and it has been found that with a fall of three feet, the dimensions of the shoot or funnel require an addition in width, to obtain that by weight of water, which the smallness of the fall will not give by velocity alone, and in the dimensions of shoot given to those of a higher class.

The following are the particulars of mills on the *Doáb* canal, divided into three classes from the depth of the fall; the width of shoot on the sill or waste-board, being 12 inches, and the discharge per second averaging 6.5 cubic feet: the diameter of mill-stones 27 inches, and thickness 12 inches;—the corn being ground into *atta* or coarse flour.

| *Class.* | *Fall of water.* | | *Atta ground per hour.* | |
|---|---|---|---|---|
| | ft. | in. | md. | seer. |
| No. 1 | 7 | 6 | 1 | 26 |
| 2 | 5 | 6 | 1 | 5 |
| 3 | 3 | 6 | 0 | 17 |

The common mills used in the Jumna and mountain-streams, are said to grind from 5 to 7 maunds of *atta* per day, or in 24 hours; the machinery being of the rudest description, the supply of water very small, and a great part of that escaping through the shoot before it touches the water wheel.

The return to Government on the mills is obtained generally by farming them out to contractors for fixed periods, who pay so much per day as long as a supply of water equal to that entered in the contract is provided, regulated by the depth of water on the sill or

* Vide Major Colvin's Report, p. 121.

waste-board; this return of course varies not only from the powers of the mill, but also from their position relatively to populous towns and cantonments. In the neighbourhood of Delhi the return is great, and demand for *atta* equally so; whereas at other points distant from towns, mills of equal power would not produce half the return. The *Doáb* canal, although possessing every advantage in fall and power of machinery, labors under a disadvantage in this respect, the town of *Saháranpur* being the only one throughout its whole extent where there is any great demand for machinery of this description. *Shámli,* although a large town, does not contain a great number of that class of people who purchase *atta,* each family grinding their own corn for home consumption; and although there are ample means for establishing mills at the south end of the canal opposite Delhi, (the canal falling into the *Jumna* with a descent of about 50 feet in a line of 12 miles !) it has been considered unadvisable to put them in extended practice, on the supposition that the mills already built on the Delhi canal in the city would suffer from the competition;—in short, that the mills *in* Delhi are sufficient to grind the corn *required* by its population.

The people from whom the millers look for profit are chiefly those of the *sipahí* class, travellers, those without families, idlers, &c. those who are regularly settled with their families, trusting as I before said to the hand-mill in their own house, and not purchasing from the mills excepting on marriages and other grand occasions, when the consumption of *atta* is more than their own mill could provide for. In military cantonments the whole of the *atta* and flour used is obtained from the mills; the vicinity therefore of a station of this description becomes a lucrative affair to the miller, in exemplification of which I may mention, that during the existence of the Provincial Battalion at *Saháranpur,* the canal mills at that place were kept constantly in their service, with little or no aid from the inhabitants of the town.

The profit derived by the renter of a mill depends in a great measure on his management, and on the rate per maund which he charges for grinding; but with an experienced and steady man, the following may be considered as a very close approximation to their daily profit. The rate per maund for grinding *atta* by the *Peesunyaris* or corn-grinders in the city, is generally three annas, for which sum they deliver the articles at the purchaser's house; at the water-mills two annas per maund is the usual charge, not however including the carriage of the grain to the mill, &c. the charge of two annas being simply for grinding.

The expenses to the miller for keeping 2 mills at work are thus,

| | | | | |
|---|---|---|---|---|
| *Per month,* | 1 head miller's wages, ...... Rs. | 5 | 0 | 0 |
| | 1 assistant ditto ditto, ........ | 4 | 0 | 0 |
| | 1 weighman,.................. | 4 | 0 | 0 |
| | Oil at $\frac{1}{4}$ seer per day, about .... | 1 | 0 | 0 |
| | 2 seers of *atta* given per day to 2 millers, in addition to their regular pay, about ............ | 2 | 7 | 0 |
| | Total expense per month, Rs. | 16 | 7 | 0 |
| | or per day, taking a month of 30 days,.... | 0 | 8 | $9\frac{1}{5}$ |

The receipts per day are as follows:

| | | | | | | |
|---|---|---|---|---|---|---|
| Supposing 55 mds. of grain ground at 2 ans. per md. | | | | 6 | 14 | 0 |
| DEDUCT. | | | | | | |
| Expenses as above,.... | 0 | 8 | $9\frac{1}{5}$ | | | |
| Government rent, .... | 5 | 0 | 0 | | | |
| | | | | 5 | 8 | $9\frac{1}{5}$ |
| Balance of profit to miller per day, Rs. | | | | 1 | 5 | $2\frac{4}{5}$ |

The above daily expenses would not be increased by an additional mill;—the profits to the contractor in that case could therefore be much increased; whereas a solitary mill would very nearly require the same establishment, and would therefore be less profitable; mills of a higher power also might be easily worked with the above scale of establishment.

At mills distant from towns, the payment for grinding corn is made in kind, varying from 2 to 4 seers per maund, which, at the usual rate of from 40 to 50 seers per rupee, is but a moderate return in comparison with that at the town mills. These village mills grind gram, barley, and Indian corn, as well as wheat.

The stones used on the canals are chiefly those from the quarries near *Agra, Rúpbas,* and *Fatihpur Sikri,* a coarse-grained sandstone which requires the chisel every second day,—there are three sizes used;

First size, diameter 36 inches, depth 12
Second ditto, — 30 inches, do.
Third ditto, — 27 inches, do.

The two latter are in most general use. Stones of the usual quality last for about 2 or 3 years, that is to say, at the end of that period a new upper stone is provided, and the old one placed below. In the native mills on the *Jumna,* stones about 22 inches diameter, and from 10 to

12 inches thick, are quarried in the vicinity of *Rájpur* north of *Dehrah*; they appear to me of an inferior description, though of various qualities ;—the native millers, however, prefer some of them to the *Agra* stone, and it is not impossible that some of the best variety from *Rájpur* may be superior to the worst from *Agra*, but generally speaking the preference is decidedly in favor of the latter.

The best method of delivering the water from the shoot on to the float-boards, appears to be that represented in the accompanying sketch, and which has been generally practised on the canals in pursuance of the usual course adopted by the natives. A trial made at Hansi, in which a horizontal (or nearly horizontal) shoot applied to the lower part of a cistern delivered the stream on float-boards whose planes were parallel to the axis of the arbor or upright, did not answer so well as was expected, owing in a great measure, it was supposed, to the introduction of a new system, which unless palpably advantageous, is certain to meet with objections from the people to whom the mills are entrusted ; but although the limits of this paper will not allow me to enter into a discussion on the point in question, I am much inclined to consider that the latter method is not only objectionable, but that the power obtained in applying it to this simple water-wheel is much less than the other; a matter to be settled by practical experiments, and not by theoretical speculations. Belidor, in speaking of a mill of this description, says, " En Provence et dans une bonne partie du Dauphiné, les moulins y sont d'une grande simplicité, n'ayant qu'une roue horizontale, de 6 ou 7 pieds de diametre, dont les aubes sont faites en *cuillerès** pour recevoir le choc de l'eau, qui coule ordinairement dans un auge ; L'arbre, qui repond à la meule supérieure, est la seule piece qui sert á lui communiquer le mouvement, et je ne crois pas qu'il soit possible de faire un moulin à moindre frais; il est vrai qu'il faut pouvoir menager une chute comme celle que l'on voit ici, et qui sont tres frequentes dans ce pays là.

" La roue tourne sur un pivot dans une crapaudine pratiquée au milieu de l'entretoise du chassis, servant à approcher les deux meules, par le moyer de la vis se qui est a l'extremité de la piece, et de l'ecrou, que l'on fait tourner pour hausser ou baissir le chassis.

" Les roues que l'on voit exécutées danse la gont de cell ci ont leur cuillères simplement assemblées a l'arbre par un tenon et une cheville,

* These cuillères, or spoon-shaped ends, are mere indentations in the native mills, and the trough alluded to by Belidor for the delivery of the water at an angle of about 25° is in the native mills a square tube or shoot placed at an angle of 45°. The crapaudine and the arrangement for raising or depressing the upper stone by the transom in which it is fixed, is also practised in the native mill.

fortifiées par le dessous par des membrures qui les entretiennent toutes ensembles." He goes on to explain a method of opening and shutting the water-course or shoot, which is of no consequence here. It will be seen however, that this mill is exactly on the same plan as that used in this part of India, and it is a pity that the account did not proceed and explain the powers of the mill, that we might draw a comparison. It would also be interesting to know whether the increased size (the Provence mill being about double the size in diameter of water-wheel, &c.) would not detract from the simplicity of the little native mill; for the great advantage of the latter appears to be the absence of complicated wood and iron-work, especially joints and iron bindings, &c. all of which increase with length of lever, or length of radii of the water-wheel: indeed the above account shews a complication of *membrures*, &c. which in the native mill are not thought of.

*Northern Doab, April* 30, 1833.

*Reference to Plate XII.*

*Fig.* 1. Elevation of the water-wheel, with the stones in section to represent the iron spindle.

At *x*, a hole of about 4 inches diameter and 4 inches deep is made in the transom, into which a quartz boulder is firmly fixed; the said stone or boulder having an indentation made in it to receive the pivot.

This pivot, as represented in fig. 4, consists of another stone of the same quality of about 4 or 5 inches long and 1 inch square, which is firmly fixed into the tail of the arbor, (see *y*.) The above stones are picked up in the beds of the mountain rivers, and are used as they are found without any stone cutting.

*Fig.* 2. Plan of water-wheel, 30 float boards of sissú wood.

*Fig.* 3. Upper joint of arbor.

*Fig.* 4. Lower joint of ditto, shewing the iron straps fixed between each float board, to keep them firmly in position, the strap represented in fig. 5.

*Fig.* 5. Strap as above.

*Figs.* 6 and 7. Float board and end of ditto; the float board 12 inches long, with a spoon sunk 4 inches.

*Fig.* 8. Iron ring that slips over the top of arbor, and holds the two joints together.

*Figs.* 9 and 10. The spindle and plate upon which the upper mill-stone turns.

*Fig.* 11. Sketch of mill stones with basket stand, &c.

*a.* Hopper or basket.

*b.* Shoe.

*c.* Feeder, or small piece of wood hanging to one lip of the shoe, and resting on the mill-stone, each revolution of which gives the shoe a jog, causing the corn to run constantly from the hopper through the shoe.

*d.* String attached to the opposite lip of the shoe, to which the feeder is, and by tightening or loosening which, the discharge of corn is regulated.

*e.* Stand.

*Fi.* 12. Shoe on a large scale: this is generally cut out of a block of *dak* (Buteâ frondosa), or any wood easily worked.

## III.—*Description of the Salt Works at Panchpadder, in Márwár.* By *Lieutenant* A. Burnes, *Bombay Army.*

At *Panchpadder,* in *Márwár,* about six miles north of the river *Súní,* there are extensive salt works under the *Jodhpur* Government, yielding to it annually considerable revenue, in a cent. per cent. tax. The tract which furnishes the salt is a spacious saline plain, about 12 miles long and six broad, commencing three or four miles westward of the town of *Panchpadder,* and hemmed in all other sides by the sand hills of the desert.

In this space there are about seven hundred salterns, each of which is 200 feet long, by 60 broad, with a depth of 12 feet. Within this space the water, which is saline, rises from the soil to a height of four or five feet; and a jungle shrub, called *Marúrí,* is carefully disposed in layers under and over it. To these the saline particles adhere and crystallize, and in the course of two years the whole depth of liquid becomes a mass of salt, the process of crystallization commencing from the bottom.

The shrub which is so essential to this process is of a grey or ashen colour, and grows in abundance on the sand hills of the *Thar* or desert. It must possess certain properties to adapt it for the purpose. In appearance it is like the *Babúl* with thorns, but no other shrub is so suited to the manufacture of salt as *Marúrí.* *Lawn,* or *laan,* a low stunted bush, like evergreen, which is always to be found in salt and level plains, is sometimes used in its stead, but the salt is then of an inferior description. The natives say, that *Marúrí* is a salt plant: it does not appear so to the taste. The fact of *lawn* serving however indifferently as a substitute for it, shews that it must be of a saline quality; for that shrub when burnt yields abundance of alkali, and never grows, but in soils impregnated with salt. The salt manufactured at *Pokran, Phalód,* and *Sámbar,* places in *Márwár,* is by a different process from what is here described, and I conclude that the use of the *Múrarí* bush is peculiar to *Panchpadder.* The salt manufactured here is said to be of a superior quality, and is exported to *Malwa, Meywar,* &c.

The whole operation of the manufacture is tedious and expensive; the price of the labour is high, from the unhealthy and disagreeable nature of the work. A saltern costs in digging from one to two thousand rupees, and only affords a return every third year, and each successive supply from it is of an inferior description. Of the seven hundred salterns, sixty or seventy might produce annually much more, but this supply satisfies the demand. Each yields on an average about 3000 bullocks, or 8000 *man* of 40 *sír,* of the material. The salterns become unfit for use after thirty or forty repetitions of the process;

they are sometimes recovered by being allowed to lie waste for a few years, and then spreading salt over the bottom of the pits; but the crystals in such cases are always small, and the salt is esteemed good or bad according to their size. When a saltern is to be again used, after the salt has been drawn from it, it is thoroughly cleared out. When the water which springs up anew from the soil begins to gurgle and shew on its surface an appearance as if rain were falling, it is time to throw in the *Marúrí*, which is carefully distributed in all places. Twenty cart loads are sufficient for a saltern.

The cold season is most favourable for the process, but crystallization goes on in the hot weather also, nor does the rain in any way injure it, indeed, it is said to favour it, though no rain water is admitted, but what falls from the clouds on the surface. The inferiority of a saltern is discovered by the quantity of water left on the surface after the period for taking out the salt has elapsed: when such is the case, it is drawn off, and the salt removed.

In forming the salterns it is a custom to sink them some depth into the consistent soil, for the first six feet is little else than sand, but the white efflorescence over it, and all the earth which is removed, shews that it is equally mixed with saline particles.

These salt works are entirely worked by a tribe of people resident at *Panchpadder*, of the *Kherewál* caste; and the *Jodhpur* Government does not interfere, but to take its tax. At present, 1830, the *Kherewál* are engaged in sinking about 30 new salterns; the salt of *Panchpadder* having of late years deteriorated from want of better management.

The scarcity of fresh water in the vicinity of these works prevents a greater quantity of salt being exported, for cattle cannot approach them after the tank or rain water fails, about March; and the inhabitants of the surrounding villages are driven to rely on the *Súní*, from which this necessary of life is brought in carts.

There is a temple of a goddess near these salt works, and to the influence of this lady, the people entirely attribute the formation of the salt and the original discovery of it. This has given SAMRA DEVI', (for that is her name,) much celebrity, as may be imagined, where, besides the *Kherewáls*, upwards of a thousand labourers are kept in constant employ.

The *Chárans*, a religious sect who enjoy many immunities, are the principal purchasers of the salt of *Panchpadder*. The article is sold by bullock loads, and not by weight; and it is amusing enough to see the poor animals walking under a *double* load, that their masters may *double* the Government, and escape a portion of the taxation; for on passing the Government toll at the town, they divide the salt into smaller loads.

## IV.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, the 31st July,* 1833.

The Hon'ble Sir Edward Ryan, President, in the Chair.

The Proceedings of the last Meeting were read.

Captain C. M. Wade, Political Agent at Lúdiána, proposed at the last Meeting, was elected a Member of the Society.

Dr. J. T. Pearson was elected Curator of the Society's Museum of Natural History.

The Secretary submitted the Report of the Committee appointed on the 27th March, regarding the continuance of the Boring Experiment [see below] which was read, and it was *resolved,* that the Society adopt the Report of the Committee, and direct it be forwarded to Government, in reply to the communication from Major Benson, Mil. Sec., &c.

The Secretary reported the completion of the second part of the 18th volume of the Asiatic Researches, or *Transactions of the Physical Class,* and submitted a bill from the Military Orphan Press, for Rupees 1962, being the expence incurred in its publication.

*Resolved,* that the bill be discharged from the fund invested in Government Securities, and that the usual distribution of copies be made.

Mr. A. Csoma de Koros' Manuscript Abstract of the Contents of the Kahgyur, and his comparative Index of Tibetan and Sanskrit Proper Names and Titles, as arranged by the pandits and Tibetan *lotsávas* (translators), when compiling the sacred books of the Shakya faith, in the Tibetan language, having been brought again to the notice of the Society, it was *resolved* to refer them to the Committee of papers, to determine on the expediency of making them over to the Local Committee of Oriental Translation Fund, with a recommendation for their early transmission to England for publication through that channel.

### *Library.*

The following books were presented:

Journal Asiatique, Nos. 57, 59, 60, 61—*By the As. Soc. of Paris.*

The third series of J. Prinsep's Lithographic Illustrations of Benares—*By the Author.*

A Meteorological Register for the first six months of 1833, kept at Kyook Phyoo—*By Colonel W. H. Wood.*

Calcutta Meteorological Register for June—*By the Surveyor General.*

The following, received from the Booksellers:

Lardner's Cabinet Cyclopedia, Spain and Portugal, vol. 5.

Lardner's Treatise on Heat.

### *Museum.*

A note was read from M. J. Bramley, Esq. presenting for the Society's Museum the following articles procured by him in Nipal.

A Chinese map of the Celestial Empire.

A map of his imperial Majesty's Durbar.

Nipalese musical instruments, curiously fashioned like snakes and dragons.

3 Horns called in Híndi "*Bhorang.*"

1 Bass Horn of copper, called *Singha*; (Beng. *Bhanh.*)

3 Hautboys or *Sanáis.*

Some Saligram Stones.

Some brass and copper images. Durga (Singh-bahní) ; Loka-na'tha, with four hands : and Goutama, or *Sakya-singh.*

Two cast leaden Shrines of Budhist images.

Two bells used in worship, *Ghantí.*

Model of a Budhist Temple, the *Chaitya*, or *Deva-pátana.*

Doctor Bramley's series of Nipalese Coins was also exhibited, and a paper in illustration of them by the same gentleman was read.

A letter was read from Raja Kalí Kishen Behadúr, presenting a model of a simple instrument on the principle of the steel yard used by the natives for weighing, called a "*toolah,*" with a description of its use.

A box was exhibited by the Secretary, containing twelve Roman copper Coins, in fine preservation, procured from a friend by the late Mr. James Mackintosh at Buxar, and stated to have been found buried in Upper India. The collection comprises coins of Domitianus, Gordianus, Gallienus, Salonina his wife, Posthumus, Victorinus, Claudius Gothicus, Tacitus, Probus, Maximianus, Constantinus, and Theodosius: the latest belonging to the fourth century of the Christian era.

Sealing-wax and paper impressions were also exhibited of some of the most rare of Dr. Swiney's collection of coins.

*Physical.*

Specimens of Coal, lately discovered in the Arracan district at *Oogadong Synegkhyong*, were presented in the name of Lieutenant W. Foley, Sub-Assistant Commissary General at Kyook Phyoo.

The specimens were necessarily small, having been transmitted by dâk. The coal of Oogadong appears of a fine quality, burning with much flame, and forming a tolerable coke; it contains veins and nodules of iron pyrites, of which specimens were sent, as also of the shale in the vicinity of the coal beds.

The specific gravity of this coal was 1.259. An analysis of 20 grains gave—

| | |
|---|---|
| Volatile matter, | 38.0 |
| Carbon, | 54.5 |
| White ash, | 7.5 |
| | 100.0 |

The Synegkhyong coal has a fine glossy lustre, resembling jet ; it is hard and brittle : contains veins of a white earth (decomposed pyrites ?)—spec. grav. 1.368. 8 grains gave on analysis,

| | |
|---|---|
| Volatile matter, | 29.0 |
| Carbon, | 67.0 |
| White ash, | 4.0 |
| | 100.0 |

Lieutenant Foley states that these specimens are merely from the surface, and that he did not possess the means of ascertaining the depth of the strata, but the appearances of the crop were highly favorable. "The stratum in which the coal of *Oogadong* was discovered was composed of—

1 Bituminous shale.
2 Coal, with clay and pyrites.
3 Claystone.

Were this claystone bored through, another and richer vein would probably be found. The mineral appeared abundant in such places as were excavated; the coal vein varying in thickness from six inches to a foot: the dip very great, or at an angle of 70°."

Lieut. F. imagines that tin and copper may be contained in the ores; but no signs of either metal were found in the specimens transmitted. Another deposit of coal is mentioned at Kalabadong; thus making four localities (with that from Kingtellie, vide page 264), already discovered in that district.

The Secretary notified the safe arrival of the specimens of *Rániganj* vegetable impressions from Dr. H. Falconer, Superintendent H. C. Bot. Gard. Seharanpur.

Accurate drawings have been made of these interesting reliques, in illustration of a catalogue of them in preparation by Doctor Falconer.

The Society adjourned its next Meeting to the last Wednesday in the month of October.

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## V.—*Report of the Committee appointed on the 27th March,* 1833, *to consider on the expediency of recommending to the Government the continuance of the Boring Experiment.*

The questions submitted to our consideration are presented under the four following heads:

1st. The probability of ultimately finding a spring of fresh water.

2nd. The expediency of making any further attempt.

3rd. The mode of avoiding such accidents as have hitherto impeded the descent of the boring instrument; and

4th. The estimated expence.

We will endeavour to pursue the subject in the same order in our present report, referring for further detail to the annexed minutes of those of our members whose practical acquaintance with engineering operations has enabled them in a great measure to guide our judgment.

1. The principal experiments on record, connected with the operation of boring for water in Calcutta, are those conducted under Colonel Garstin, Chief Engineer, from 1805 to 1820, and those recently made under the superintendence of Dr. Strong, Mr. J. Kyd, and Mr. D. Ross, in 1829 to 1833. The following is a list of their localities and of the depths respectively attained*:

* Vide Gleanings, i. 114, or 167; iii. 124, 422, &c. also As. Res. 1814.

| *No.* | *Date.* | *Superintendant.* | *Place.* | *Depth.* | *Cause of failure.* |
|---|---|---|---|---|---|
| 1 | 1804, Dec. | Col. Garstin, | Well near Powder Mag. | 75 ft. | |
| 2 | 1805, Aug. | ditto, | S. W. of Artillery Barrack, | 119 | auger broke. |
| 3 | Sept. | ditto, | S. E. of Regimental Parade, | 55 | ditto. |
| 4 | Oct. | ditto, | S. E. of European Barrack, | 59 | ditto. |
| 5 | Nov. | ditto, | S. W. of Artillery Parade, | 80 | ditto. |
| 6 | Dec. | ditto, | ditto | 127 | ditto. |
| 7 | 1806, Feb. | ditto, | ditto | 94 | ditto. |
| 8 | Mar. | ditto, | ditto | 124 | earth fell in. |
| 9 | Apl. | ditto, | same operation resumed, | 127 | auger broke. |
| 10 | 1814, May, | ditto, | S. E. of Artillery Parade, | 140 | suspended by rains |
| 11 | Nov. | ditto, | the same renewed, | 136 | auger broke. |
| 12 | 1819, May, | ditto, | on Artillery Parade, | 130 | ditto. |
| 13 | 1820, Apl. | ditto, | ditto | 122½ | ditto. |
| 14 | May, | ditto, | Near triangular barrack, | 128 | earth fell in. |
| 15 | 1815, | Mr. Jones | found a spring in red sand at | 70 | feet. |
| 16 | 1826-8, | Dr. Strong, | bored in the Circular Canal to | 70 | water rose. |
| 17 | | he also | made several borings in the S. W. lake to | 40 | thro' similar strata. |
| 18 | | Dr. Strong | near the Circular Road, | 70 | hard kankar. |
| 19 | | ditto | at Rasapugla, | 70 | sand fell in. |
| 20 | 1830, | Strong, Ross, and Kyd, | near the Fort church, | 176 | shaft injured. |
| 21 | 1832, | ditto, | near St. George's Gate, | 164 | sand fell in. |
| 22 | 1833, | ditto, | ditto, | 170 | auger broke. |
| 23 | 1832, | Dr. Strong, | under the Lock Gates, Chitpore, | 70 | water sprang up. |

The *geological* question of the probability of finding a spring is by no means solved by the results of these numerous experiments. The knowledge which they afford us of the nature of the Calcutta alluvium may be summed up in very few words:—(See Plate XIII.)

After penetrating through the artificial soil of the surface, a light blue or grey-coloured sandy clay occurs, becoming gradually darker, as we descend, from impregnation with decayed vegetable matter, until it passes into a stratum of black peat, about two feet in thickness, at a depth in Fort William, of 50 feet below the surface. In excavating the Circular Canal, the same stratum of peat occurred at from 25 to 30 feet; and in the Entallee Canal, it lay just below the bed, or nine feet below the average level of the salt-water lake.

This peat stratum has all the appearance of having been formed by the debris of *Sundarban* vegetation, once on the surface of the Delta, but gradually lowered by the compression of the sandy strata below. Assuming that the salt-water lake is five feet above the average height of the ocean, the peat stratum is about as much more below the present level of the sea.

In the grey or black clay above, and immediately below, the peat, logs and branches of a red* and of a yellow wood† are found imbedded, in a more or less decayed state. In only one instance have bones have been met with, (at 28 feet), and they appear from the report of the workmen to belong to

* The common Súndri of the Sundarbans.

† The root of some climbing tree, resembling the Briedelia. N. WALLICH.

deer, though they were unfortunately lost before examination. A stratum of sand occurs generally above the peat clay at from 15 to 30 feet deep, from which the wells in the town are chiefly supplied with brackish water.

Under the blue clays at from 50 to 70 feet deep, the nodular limestone concretions, known by the name of *kankar*, occur, sometimes in small grains (called *bajrí* in Upper India) with the appearance of small land shells; sometimes in thin strata of great hardness, and sometimes in the usual nodular shape.

At 70 feet occurs a second seam of loose reddish sand, which yields water plentifully. It was reached also in the perforation under the Lock Gates at Chitpore, and there (as Mr. JONES had previously asserted from his own experiment across the river), the supply was proved to be derived direct from the river.

From 75 to 125 feet, beds of yellow clay predominate, frequently stiff and pure, like potter's clay, but generally mixed with sand and mica. Horizontal seams of kankar also run through it, resembling exactly those of Midnapur or of the Gangetic bason.

Below 128 feet a more sandy yellow clay prevails, which gradually changes to a grey loose sand, extending to the lowest depth yet penetrated; and becoming coarser in quality until at 170—176 feet, it may rather be termed a quartzy gravel, containing angular fragments of quartz and felspar larger than peas, such as are met with near the foot of a granitic range of hills.

This stratum has hitherto arrested the progress of the auger; the greatest depth attained by Dr. Strong near St. Peter's Church being 176 feet.

The evidence of this gravel might tend to prove that the auger had here penetrated through the bed of alluvium of the Gangetic delta; while the sandy texture of the undermost layers might be compared to the probable condition of the deposits under the now advanced head of the bay, not yet reached by the more easily suspended particles of clay, nor consolidated by vegetable matter, like the tenacious black mud of the *Sundarban* creeks.

Nevertheless, we must be cautious in forming any such conclusions upon slight premises, remembering that Colonel GARSTIN more than once, concluded from similar appearances that he had reached the *rock* at 130 feet. Beneath the quartzy sand may possibly occur another deep stratum of tenacious clay, and upon piercing every such stratum, and touching a seam of sand under it, the chance offers of succeeding in the object of our search.

It is true that the horizontality of the delta alluvium, and its close neighbourhood to the ocean, afford arguments against the probability of finding an *artesian* spring upon the hypothesis of Hericart de Thury*, that is, of basons and curved or sloping strata,—which is generally adopted as affording the best explanation of the phenomena of such springs: but in face of the successful borings in Holland, and in many other flat and alluvial countries, nay even in insular situations, it would be hazardous even in a

* See GLEANINGS, iii. 10.

geologist to predict want of success in Bengal, unless he was well assured that the rocks under the alluvium were of the granitic or unstratified class.

The depth yet attained is very trifling, and we all concur in thinking that the experiment should not be relinquished, until the ground has been pierced at least to the depth of 500 feet. Borings in Europe seem seldom to have been undertaken upon purely scientific principles or expectations; sometimes they have started in direct opposition to them, and yet obstinate perseverance has frequently been crowned with success: so may it be in India. While drawing up our report, we hear of the eminent good fortune which has attended Lieut. FULLJAME's attempts in *Guzerát,* at *Ahmedábad**, where water rushed up with great force through the tubes to the astonishment of the inexperienced in such matters. The soil of the plains in *Guzerát* is so sandy and unretentive of moisture, that most of the wells have a depth exceeding 100 feet. But we have not sufficient knowledge of the country to draw any deductions applicable to our own position in Bengal.

2. In reply then to the second query, we are of opinion that it is by all means expedient to continue the boring, and were the Society in a condition to afford the funds necessary, we should be sorry to see the honor of its superintendence transferred to other hands.

3. The accidents which have hitherto impeded the progress of the auger below 175 feet, are entirely attributable to the falling in of the lower sandy stratum, an increasing difficulty against which no sufficient remedy has been provided. All perseverance in boring, as long as this impediment exists, or is not counteracted, has been, and will be, an absolute throwing away of money and time.

The remedy always adopted in such cases of bad soil at home consists in lining the perforated hole with copper or cast iron tubes well united with spigot and faucet joints.

It is therefore indispensable that these articles be provided before the boring can proceed or be renewed. The tubes may either be supplied from England, or now that the casting of iron is practised in India, they may be made here: the expence however in the latter case is estimated by one of our members at full double the English cost, and there is a chance of failure in the texture of the metal from the want of raw material to fuse with the fragments of old cast iron of which the fount usually consists in India. It seems therefore preferable to commission the tubes at once from England†, giving the manufacturers every information regarding the nature of the soil and the depth, that they may adapt the most convenient lengths to the tubes of the different grades and sizes. At the same time, any new tools or apparatus for facilitating the operation may be commissioned out.

* The boring was commenced at the bottom of an abandoned well.

† We understand that a large supply of cast-iron tubes and boring rods was brought out for Madras by the H. C. S. Buckinghamshire this season.—ED.

There is no reason, however, why trials should not be made meanwhile at the Government foundery, to model and cast some of the tubes, as, if successful, there would be ample employment for them in various parts of India. Much of the delay experienced in the latter borings has been attributed to the shortness of the jointed rods, and the necessity of unscrewing them so often. It has occupied, on an average, five hours to lift 170 feet of rod, and the daily progress at that depth has consequently been seldom more than a foot: although a gradual improvement has taken place with the growing experience of the workmen. Thus to bore the first shaft of 175 feet, consumed two years: the second of 164 feet was completed in one year, and the third, of 170 feet, in less than six months. Colonel Garstin's operations seem to have been much more rapid, but the time, it must be remembered, augments in a geometrical ratio with the depth. That officer had, further, a more efficient establishment at his command.

A new set of stronger and longer boring rods might facilitate operations, but these and all such other details may safely be left to the discretion of an experienced Superintendent, such as Serjeant Reid, whose ingenuity will supply expedients as accidents may occur to necessitate them.

Should the Government undertake the experiment, it may perhaps be deemed of sufficient importance by the Honorable the Court of Directors, to send out engineers especially versant in the art of boring the earth. At any rate we venture to suggest the advantage of having all men, intended for their Sapper and Miner service, instructed in the practical part of the operation as a part of their professional education at Chatham.

With all these precautions, we do not anticipate the recurrence of any further insurmountable impediments to the auger, until it may reach the actual rock.

4. With regard to the expence of a new experiment, we have been informed that six hundred feet of tube may be provided for less than £150. The Society has expended on three protracted operations, including the cost of wrought iron tubes, &c. about Rupees 3,000. We cannot therefore estimate that one steady experiment, tubes included, will cost so much as these three unsuccessful attempts. And in the hands of a Government, which has the power of deputing its own officers and men to conduct the work on duty, nothing beyond the small contingencies for repairs of rods, wear and tear of ropes, &c. can properly be set down to the charge of the experiment.

Should nothing further be elicited after penetrating 500 feet, or even "to the rock," than the knowledge, that a spring of fresh water is not thus procurable, it will in our opinion be knowledge cheaply bought; and although geological research is not to be put on a par with the direct and political object of providing wholesome water to the garrison of Fort William, still an acquaintance with the depth, variety, and nature of the alluvial deposits, which separate us from the rocky crust of the globe, and of the coincidence of the subjacent strata with some of the rocks which have been developed to our view above ground, by geological or physical causes, cannot but prove interesting to the Government, to the scientific world, and to mankind in general.

(Signed,) W. H. MILL, D. D. *V. P.*
W. N. FORBES, *Capt. Engineers.*
J. M. SEPPINGS.
J. LANGSTAFF.
J. N. CASANOVA, M. D.
N. WALLICH, M. D.

*Asiatic Society's Apartments,*
*20th July,* 1833.

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## VI.—*Miscellaneous.*

### *Remarks on Hutton's Mathematics.*

To the Editor of the Asiatic Journal.

SIR,

I observe occasional strictures on mathematical and physical works in the miscellaneous department of the Journal : I am therefore induced to send you the following observations on some passages in Dr. HUTTON'S Course, which if not inconsistent with your plan you may perhaps find a place for.

The first subject of remark is the Doctor's method of treating the hyperbola in his conic sections*. Here he appears to have made it too much his object to point out the strong analogy which subsists between it and the ellipse, which is indeed both striking and interesting ; but in keeping to this one point he has sometimes gone too much on the general idea, and has not attended sufficiently to the specific properties of the curve in question, giving his demonstrations in the same words for both these sections of the cone, in one or two instances, where the correspondence was scarcely close enough to admit of this method of procedure.

To come to particulars. In Prop. I. the squares of the ordinates are proved to be to each other as the rectangles of the abscisses, but only be it observed in regard to the *primary* curve. In Prop. II. Dr. H. comes to shew that the square of the transverse is to the square of the conjugate as the rectangle of the abscisses to the square of their ordinate ; but his first step consists in assuming the semi-conjugate to be an ordinate to the curve. Now this I contend is premature, for of the conjugate hyperbola nothing has yet been said, but that it exists, and this in the definitions only.

The difficulty might perhaps have been evaded by adding after Prop. I. something similar to the following : SCHOLIUM. "The above proposition, as the reader will observe, is identical with Prop. I. of the ellipse, but the analogy between the curves is yet closer than these corresponding properties of the abscisses and ordinates would at first sight suggest ; for if, as in the ellipse, the square of the axis A B is made to the square of another line passing through the bisecting point at right angles to A B, and bisected by A B, as the rectangle under the abscisses of an ordinate to the square of that ordinate, it will be a conjugate axis to A B corresponding to the conjugate axis of the ellipse, through which conjugate curves passing complete a conformity between these two sections of the cone, which is very close and remarkable."

From Prop. II. all goes on with apparent smoothness till Theor. X, where in proving that the parallelograms inscribed between four conjugate hyperbolas

* See on this head 𝕿.'s paper in GLEANINGS, iii. p. 161, 213.—ED.

are equal to each other, and to the rectangle of the two axes, it is assumed that in Prop. VII. it had been shewn, that if a tangent and ordinate be drawn from any point in the curve meeting the transverse axis, the semi-transverse will be a mean proportional between the distances of the said intersection from the centre, whether the curve be the one cutting the said transverse or its conjugate, whereas it has only been shewn in the former case. There is to be sure no great difficulty attending the demonstration of the latter case, when the former is given; but still it is an obstacle every reader will not take the trouble to master, nor perhaps every teacher be at the pains to make his pupil overcome.

I will only add one other remark at present, and that on a subject closely connected with what precedes. In the demonstration of the problem of the trisection of an arc, vol. III. p. 217 a step has been omitted. It follows from Cor. Theor. 2 that in the equilateral hyperbola the rectangle of the abscisses is equal to the square of the ordinate, and after a short deduction by Theor. 18 "to $K \cdot KI = AK^2$." the last reference has not been given.

*Tirhoot, 19th June.* L. D.

## 2.—*The Royal Society.*

The annual address of the Duke of Sussex to the Royal Society* evinces a real desire on the part of the Royal President to identify himself in its interests, and to awaken a new and *reforming* spirit in this veteran establishment, which has of late years exhibited rather more indulgence in the election of its members, and the selection of its papers for publication, than was consistent with the dignity of *la haute science.* The council it seems have taken the hint of Mr. Babbage to submit every paper to a Committee previous even to its being read. We have before remarked†, that the custom of the Academies of Science and Medicine at Paris, of requiring such written reports, has produced a collection of essays on all subjects in general more valuable than the original communications upon which they are founded, because the persons who are selected as Committee men are "veterans in their respective sciences, who have earned by their labours an European reputation." The class of *savans* however to which these duties are entrusted in Paris is nearly wanting in England, where the Members are not supported by Government pensions, and there are few private professorships in which the *otium* of dignified retirement can be devoted to such objects; while for the rich amateur or the laborious practitioner the task would be alike unwelcome and unsuitable. The President however is satisfied that qualified men will be found ready to sacrifice both time and labour, out of their sympathy for the scientific honour of their country. We hope to find these expectations realized in respect to the Royal Society; and we would suggest that the plan of reports on papers should be introduced in our own society: the reports will be more useful here to shew upon what studies our members are engaged, because so long an interval generally ensues before their original papers are doomed to see the light.

The obituary catalogue of the past year is heavily charged. Sir Everard Home, the author of 107 papers on comparative anatomy in the Transactions; Sir James Hall, the *experimental* supporter of submarine volcanic agency; Groombridge, the

* Printed in the Phil. Mag. Feb. 1833.

† Vol. i. p. 367.

astronomer; LESLIE, the chemist (not a F. R. S.)* ; of foreign members, the great CUVIER ; CHAPTAL ; the Baron de ZACH, and B. ORIANI, astronomers ; Ant. SCARPA, the anatomist, have all bequeathed their illustrious names to science. Sir JAMES MACKINTOSH and Colonel MARK WILKS, we may in some measure lay claim to ; the former was for eight years Recorder of Bombay, the latter is known for his Researches on the History of Mysore : let our readers reflect upon the advantages which the PRESIDENT supposes them to possess from their Indian training.

"Colonel WILKS must be considered as one of those distinguished men who have been formed by the system of our Indian Empire. The possession of great commands, upon which the happiness and misery of considerable nations are dependent, and the intense feeling of responsibility, which is connected with the administration of trusts so important, is well calculated, under all circumstances, to call forth into action the highest powers of the human mind ; and particularly so, when they have been previously exercised and fortified, as in our Indian service, by the severe study of oriental languages, and by the successive occupation of different offices, with a great diversity of duties : it is to such causes that we are to attribute the frequent union which we observe in this service of the greatest civil and military talents with the most profound acquisitions in oriental learning ; it is to this system that we are indebted for the production of a DUNCAN and a MUNRO, an ELPHINSTONE and a RAFFLES, a COLEBROOKE and a MALCOLM, and a crowd of great men who have done so much honour to our Indian Government."

At the conclusion of his address, the President alludes to the precarious position of Captain Ross and his companions. It is more than three years since he started on his forlorn expediton, to retrieve the glory which he considered had been shorn from him by the greater success of others in the exploration of the Polar Sea ; and no tidings have been yet received of him. A vessel is now preparing, under the auspices of the Geographical Society, to pursue the supposed track of the party, and if possible relieve the anxiety of their friends and relations with some certain intelligence of their fate.

### 3.—*Discovery of a Bed of Fossil (Marine ?) Shells on the Table Land of Central India.*

A circumstance which must prove highly interesting to all lovers of geology, has lately been brought to light by the discovery of a bed of fossil shells (marine ?) in a good state of preservation. Accident, as usual, in discoveries of this kind, led to their detection. A well had been sunk some 14 years ago by a native, half a mile distant from Saugor, beside the road leading to Jubbulpore, and with the stones turned out of it, he erected a small hut for his workmen, little dreaming at the time he was piling up such geological treasures. A man the other day, seeing something unusual in a lump of the limestone of which the hut was built, dragged it out, and took it to his master, Mr. Fraser, who immediately recognized it as being a shell. So interesting a fact could not be lost sight of, and means were immediately taken to follow up the discovery. On searching the walls of the dwelling, several other stones equally rich in shells were detected, and the owner of the

* Professor BARRY, Lecturer at GUY'S, fell a victim to the imprudent pursuit of his chemical inquiries, from the explosion of some gases in a highly condensed state, upon which he was experimenting.

ground being questioned; stated, they came out of the well about half way down; but ocular proof was not to be obtained, from the sides of the well being stoned up with large blocks of sandstone. To allow a point of so much interest to remain in doubt would have been highly culpable, and Dr. Spry immediately set about sinking a shaft parallel to the well, that the locale might be effectually set at rest.

After sinking through basalt, both soft and hard, he came, I understand, upon a bed of soft fatty red soil, containing nodules of lime, and presently reached the anxiously sought limestone bed, from which he had the satisfaction of disentombing some rich specimens of shells. The bed is formed exactly 17 feet below the present surface. The shells are univalved of different sizes—some nearly as long as the hand, and all of them are what is termed *reversed* shells*. I understand, however, he is proposing to send an account of them to the Asiatic Society, and I shall not therefore venture to do more than announce the discovery to you.—*Mofussul Ukhbar.*

## 4.—Indian Zoology.

*Extracts from the Proceedings of the Zoological Society, April* 10, 1832.

Mr. Gray enumerated the following species of the genus *Paradoxurus*, all of them as far as their *habitat* has been ascertained, natives of India and the Indian Islands.

1. *Paradoxurus Typus.* F. Cuv., Mamm. Lith.
   Genette de France. *Buff., Hist. Nat. Suppl.* iii. t. 47.
   Viverra nigra. *Desm., Mamm.* p. 208.

This species appears to be the *Musk* and *Musky Weasel* of Pennant's Quadrupeds, both taken from Sir Elijah Impey's drawings, but not the *Piloselle Weasel* of the same author, which has hairy soles. There is a variety now living in the Gardens of the Society, which may be called *fuliginosus*, it being nearly black in consequence of the length and number of the black hairs, which only show the fulvous under-fur between their roots. It has a very distinct pale spot above, and another beneath, the eye.

The three following species are only known by the drawings of Dr. Hamilton and Gen. Hardwicke, the former of which were liberally lent to Mr. Gray by Dr. Wilkins and Dr. Horsfield, in order to enable him to determine by actual comparison the species described from them by M. de Blainville. The first two appear to agree with *Par. Typus* in having nearly naked ears, and may possibly be the only varieties of that species; the third approaches more nearly to *Par. Muangas.*

2. Paradoxurus Pennantii. *Par. pallidè cinerascenti-brunneus, fasciis obscuris saturatioribus lateralibus; auriculis nudiusculis; orbitis albidis; artubus caudæque dimidio apicali nigrescentibus.*

This animal is stated by Gen. Hardwicke, from whose drawings the character is taken, to be found in the upper provinces of Bengal, and to be very destructive to poultry and game. Its head and body measure 21, its tail 23,—making a total length of 44 inches. The ears and sides of the nose are pale flesh-coloured.

* The same curious fact is observable in the silicified fossil shells lately presented by Dr. Spilsbury to the Asiatic Society.—Ed.

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Ichneumon Bondar. *Ham., MSS.*

3. *Paradoxurus Bondar.*

Viverra Bondar. *Blainv., in Desm. Mamm.* p. 210.

This species inhabits Bengal, where it is called the *Musk-Cat.* Its head and body measure 25, its tail 24,—making a total length of 49 inches. Dr. Hamilton's reduced figure, from which this animal was described by M. de Blainville, agrees with Gen. Hardwicke's drawing in almost every particular, except that in the former the nose is rather sharper, and the tail not quite so bushy as in the latter.

4. *Paradoxurus prehensilis.*

Ichneumon prehensilis. *Ham., MSS.*

Viverra prehensilis. *Blanv. in Desm. Mamm.* p. 208.

This species is only known from Dr. Hamilton's drawing; it appears distinct from any of the others, more especially in the bands of the sides of the back being formed of oblong nearly confluent spots, and in the length of the tail, which has a long white tip. The central dorsal streak is not very distinctly marked, and the dark line in the drawing may perhaps be intended for the shadow.

5. *Paradoxurus Musanga.*

Viverra Musanga. *Horsf., Zool. Res.* t. 5.

Viverra fasciata. *Desm., Mamm.* p. 209?

The very young animal is pale ash-coloured, with three distinct black dorsal bands, and the sides spotted. Its fur is very close and soft, mixed with scattered very rigid rather longer black hairs.

6. Paradoxurus dubius. *Par. pallidè flavescenti-cinereus, pilis dorsi longioribus apice brunneis, subtùs flavescenti-albidus; dorso fasciis centralibus tribus, lateribusque maculis brunneis inconspicuis; capite, auriculis pilosis, pedibusque castaneis; caudâ præter imam basin negro-brunneâ: maculæ utrinque adnasum, alterius supra genas, fasciæque interauricularis transversæ pilis albo-apiculatis.*

This species is described from a young specimen sent to the British Museum by Dr. Horsfield: it may be only a variety of *Par. Musanga,* but cannot be the general state of the young of that species, which is described above. It is probably the Javanese variety of the *Musang* described and figured by Dr. Horsfield.

7. *Paradoxurus hermaphroditus.*

Viverra hermaphrodita. *Pallas, in Schreb. Säugth.* p. 426.

The description of the glandular fold between the *anus* and *penis* proves this species, which is only known by Pallas's description, to be a *Paradoxurus.* It appears to resemble the preceding, but differs in having the entire throat black, and in its black dorsal bands.

8. Paradoxurus Pallasii. *Par. nigrescenti-griseus, nigro alboque intermixtus, infrâ pallidior; dorso fasciâ latiusculâ maculisque parvis utrinque biserialibus nigris; artubus, lateribus infernè, caudâque nigrescentibus; facie nigrâ maculâ utrinque ad nasum, alterâ sub oculos, fasciâque transversâ per frontem pone genas ad gulam usque ductâ, albis; auriculis nudiusculis; gulâ anticè, nigrescenti-cinereâ, posticè cinereo-albidâ; caudâ corpore longiore.*

Par. albifrons. *List in Report of Council Zool. Soc.* 1831, *haud F. uv., Mém, Mus.* ix.

This species is described from a living specimen in the Gardens of the Society brought from India, and presented by Mr. Buchanan.

9. Paradoxurus Crossii. *Par. suprà nigrescens, pilis plumbeis nigro-apiculatis, infrà flavescens, pilis albo-apiculatis ; auriculis apice nudiusculis ; facie auriculis externè ad basin, pedibus, caudæque dodrante apicali nigro-brunneis ; maculâ rotundâ palidâ ad nasum utrinque, alterâque minore sub oculos ; fronte flavescente.*

The length of the head and body is 21 inches, of the nose to the front of the ear 3½, of the tail 16, of the fore-foot to the elbow-joint 4½, and the distance from the back of the fore-foot to the front of the hind-, 8 inches. The species is described from a specimen lately living in the Surrey Zoological Gardens, and since presented by Mr. Cross to the British Museum, where both the skin and skeleton are preserved.

10. *Paradoxurus leucopus.* Ogilby, in Zool. Journ. iv. p. 304.

11. Paradoxurus Hamiltonii. *Par. auriculis pilosis ; dorso griseucinerascente-pilis nigro-apiculatis intermixtis, seriebus sex vel septem macularum rotundarum nigrarum ; facie dorso concolore, strigâ angustâ nigrâ inter, alterâque utrinque suprà, oculos ; fasciâ nuchali mediâ nigrâ, laterali utrinque breviore pallid-brunneâ ; pedibus dorso concoloribus ; caudâ corpore sesquilongiore, rufescenti, brunneâ, annulis angustis subæqualibus nigris versus apicem remotioribus.*

This species is described from a living specimen in the Surrey Zoological Gardens, which has been in Mr. Cross's possession about two years.

12. *Paradoxurus larvatus.*

Gulo larvatus. *Ham. Smith, in Griff. An. Kingd.*, ii. p. 281.

Viverra larvata. *Gray, Spic. Zool.* p. 9.

Paguma larvata. *Gray, Proc. Comm. Zool. Soc.* i. p. 96.

13. Paradoxurus trivirgatus. *Par. nigrescenti-griseus, infrà griseus ; capite saturatiore ; dorso fasciis tribus longitudinalibus mediis nigrescentibus ; pedibus caudâque corpore longiore nigris ; fascie immaculatâ.*

Viverra trivirgata. *Reinw., Mus. Leyd.*

This species is described from a specimen, in the Leyden Museum, sent from the Moluccas. The teeth agree with those of the genus in every particular, except that the cheek-teeth are rather shorter.

14. *Paradoxurus ? binotatus.*

Viverra binotata. *Reinw., Gray, Spic. Zool.* p. 9.

Mr. Gray referred this animal to the genus *Paradoxurus* with some doubt, he not having seen the teeth. Its walk, however, is truly plantigrade. The *habitat* of Ashantee, given to it in the Leyden Museum, may be questioned : it was obtained from an old Dutch collection, in which it is possible that the localities were not strictly preserved.

To this enumeration Mr. Gray added the indication of an animal known only by a rough sketch brought by Mr. Finlayson from Siam, and deposited in the Library of the East India Company. This he proposed to call *Paradoxurus Finlaysonii*, and described as being pale-brown ; with a band across the middle of the muzzle, and another across the orbits (including the eyes, and expanding on the back of the cheek), the ears, and three continuous narrow lines along the middle of the back, blackish brown ; the feet blackish ; and the tail cylindrical. He also considered it probable that the *Civette de Malacca* of Sonnerat, *Voy.* t. 91, the *Viverra Malaccensis* of Gmelin belonged to this genus, with which it agreed in several particulars of its mode of colouring, although it differed in having a black streak along the middle line of its belly, a character confined to few among the *Mammalia.*

With respect to the *Paradoxurus aureus* of M. F. Cuvier, he stated that he was inclined to believe that it really belonged to the genus on account of its naked soles, but was certainly not, as had been imagined, the young of *Par. Typus.*

Mr. Gray added, that figures of the *Parr. Pennantii, Bondar, prehensilis, Pallasi,* and *Hamiltonii,* are engraved for the forthcoming No. of the 'Illustrations of Indian Zoology.'

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## VII.—ANALYSIS OF BOOKS.

***Result of Astronomical Observations made at the Hon'ble the East India Company's Observatory at Madras. By* Thomas Granville Taylor, *Esq. Astronomer to the Hon'ble Company. Vol. I. for* 1831.**

The Madras Observatory has long since established its character, as well for laborious diligence in the proper duties of its professional calling, as for other collateral researches which naturally fall into the hands of a scientific astronomer. Under Mr. GOLDINGHAM's superintendence four ponderous foolscap tomes of astronomical observations were given to the public, and one volume of "Papers" containing miscellaneous matter of great interest.

From the imperfection of the instruments then attached to the establishment, (a 20-inch transit instrument, a 12-inch altitude instrument, and a zenith sector,) the astronomical results were not of a class to satisfy expectations in the present advanced state of that science. In other investigations Mr. Goldingham's name will be long quoted as of paramount authority. His pendulum experiments at Madras, and on the equator, are of the highest value: his determination of the velocity of sound under different pressures, temperatures, and directions of the wind, from a very long series of experiments, is most conclusive and satisfactory: and his meteorological series for 21 years, although unfortunate in the hours selected for the Barometer, contains abundant means of fixing the curves of temperature and pressure for the latitude of Madras.

But the present volume (printed also in a better form and type), is the commencement of a new and purely astronomical series. We may date the regeneration of the Madras establishment from the year 1830, when a 5-feet transit instrument, a 4-feet mural circle, and a 5-feet telescope equatorially mounted, which had sometime previously arrived from England, all made expressly for the observatory, were set up for use upon a solid and insulated basement of masonry, 45 feet long and 12 feet broad, tapering to 6 at top, and 7 feet high.

With every particular of the adjustment of the new instruments, Mr. TAYLOR makes us fully acquainted: the setting up and the error of the meridian mark: the errors of level, of collimation, of azimuth, and of the clock, for every day of the year; and the formula applied in each case for the necessary corrections. Mr. TAYLOR is so far of the *French school* that he prefers computing the corrections due to each observation rather than attempting to avoid them by continual adjustment of the screws of his instruments, and in this practical maxim we concur with him from experience; the more immovable the standing parts of an instrument remain, the more consistent and even will the observations be found.

The results of our astronomer's labour are not only most creditable to himself, but they prove how much may be effected by steady, well-instructed native assistants; for during the six months of Mr. TAYLOR's deputation to Calcutta, to assist in measuring the Barrackpúr Base, for the great Trigonometrical Survey, the four pundits attached to the observatory had entire possession of the transit, the mural, and the Satellite telescope, and very few cases occur in which there is room to note "*unaccountable*," against an entry in the register: at first only some malicious intruder was constantly giving annoyance by breaking the cross wires of the transit, as if to try the patience of the new master.

In all computations of results, the observatory itself is made to furnish the data; this also is a proper rule, for the climate, temperature, or clearness of the air have influences on refraction, and irradiation, which should not be trusted to estimated values. Thus, our author finds the mean diameter of the sun 16′ 0″·15, differing (how much ?) from European determinations. The effects of irradiation are closely connected with the sensibility of the eye. Differences of six or eight seconds will occur with different observers, and, Mr. TAYLOR says, it is no difficult matter in Dr. MASKELYNE's catalogues to discover when a new assistant came, from this circumstance.

Following the tables of the sun's diameter, we have a very full table of R. A. and N. P. D. of the sun, with the errors of the Tables computed for each observation, and from these the deduced obliquity of the ecliptic for 1st January 1831 is found

From observations near the summer solstice = 23° 27′ 40″· 41.
From do. .. .. .. .. winter solstice = 23° 27′ 38″· 98.

or after correcting Goldingham's latitude of the observatory, by — 0″· 71,

The mean obliquity = 23° 27′ 39″·7 : in the Naut. Alm. it is 23° 27′ 42″·1.

But we have not space to enter into detail, and must confine ourselves to the heads of Mr. TAYLOR's results.

A table of the deduced error of the equinoctial points follows: and then we have the A. R. and N. P. D. of the several planets, including the Georgium Sidus.

Towards the determination of the longitude, we have 84 comparisons of observed R. A. and N. P. D. of the moon, with her interpolated place from the Nautical Almanac; one lunar eclipse; and 21 eclipses of Jupiter's Satellites.

Mr. TAYLOR here also notices the different effects of irradiation upon different observers, which cause the semi-diameter of the moon to appear variable in its value, and necessitate an equal series of observations on both limbs to find the true passages of the moon's centre*.

No attempt is made to deduce the longitude from the lunar transits, because sufficient dependence cannot be placed on the lunar tables. The observations are however all compared with the interpolated place of the moon, from the Nautical Almanac, and the errors of the tables set forth: they vary from + 15 to — 17 seconds in time.

The mean of the 1st and 2nd Satellite observations gives the longitude from Greenwich, 5 hours, 21 minutes, 5.4 seconds, differing about a mile from Mr. GOLDINGHAM's determination. Out of 51 observations of stars culminating with the moon,

* In a series of lunar transits observed at Benares, with an 18-inch instrument, there was always a difference between the observed and calculated times of the moon's diameter passing the meridian, of nearly a second in time.—*Orient. Mag.* vii. *p.* 32, *App.*

(not *calumniating* her, as the Printer's devil has made it,) at Madras, five are provided with corresponding sights at the Greenwich observatory, and six with the same at the Cambridge observatory. From these the Madras longitude comes out 5 hours, 21 minutes, 3·7 seconds.

For the latitude we have 160 observations N. P. D. of selected stars with the mural circle *by direct vision*, and 171 *by reflection from a trough of mercury;* the extreme difference amounts to 6″, and the latitude deduced from the whole is 13° 4′ 9″·21 N.

The comet of January, 1831, was followed as accurately as the extreme faintness of the object would admit, from the 7th January to the 20th February: its position was as follows:

| | h. | m. | s. | | | | |
|---|---|---|---|---|---|---|---|
| Jan. 8. Comet's A. R. | 17 | 29 | 27 | N. P. D. | 102° | 34′ | 10″ |
| Feb. 20. —— do. —— | 12 | 38 | 49.9 | | 79 | 23 | 52.6 |

The last fifty pages (one third of the volume) are occupied by a valuable and important table of the places of the fixed stars, with reduction of the Madras catalogue to the 1st January, 1831, and the differences of each star in A.R. and N. P. D. from the Greenwich and the Astronomical Society's Catalogues.

"Of 423 comparisons of right ascension, between the Madras and Greenwich catalogues, there are 376 cases in which the difference does not amount to two-tenths of a second in time; of the remaining 46, there are 34 within three-tenths of a second; these have been carefully re-examined and found to be affected with a much less probable error than this amount; of the 12 cases which exceed seconds 0.3, three are confirmed by the Astron. Society's catalogue, and four only require further examination." This evidence speaks highly of the value of the Madras results, and they are not diminished by the larger proportion of discrepancies with the extended catalogue of the Astronomical Society, in which many stars have been brought forward from the less perfect tables of 1755 and 1800. "Out of 863 comparisons which this catalogue affords, there are 615 which do not exceed half a second; of the remainder many are confirmed by the Greenwich catalogue, or by subsequent observations at Madras in 1832."

In north polar distance the same accuracy prevails: out of 489 comparisons with Greenwich, 197 differ less than 1″·5; 122 less than 2″·5; and 115 less than 4″·0: and out of 1114 comparisons with the Astronomical Society's catalogue, 693 come within 4″; 315 between 4″ and 8″; and 105 exceed 8″.

In a few years, therefore, we may confidently expect the "Madras Catalogue of fixed Stars" to be appealed to as authority equivalent to that of either Greenwich or Berlin. In the name of every lover of the sublime science in this country, we would strongly recommend Mr. Taylor to publish annually, in advance (and we offer him our columns for the purpose), a short and authentic ephemeris of the principal celestial occurrences, to be attended to by astronomers in India, such as occultations of stars by the moon; Jupiter's Satellites; oppositions of the planets; transits and eclipses, &c. These should all be calculated for the meridian of Madras, to which as the nearest point of corresponding and nearly simultaneous observation, our observation should be referred. Meantime every Indian astronomer should provide himself with the volume before us, as containing besides the catalogues of stars, a variety of useful and practical formulæ for the correction and reduction of observations.

## VIII.—*Meteorological Table kept at Bancoora, for the year 1832, by John MacRitchie, Esq.*

| Months. | Lowest Ther. | Highest Ther. | Diurnal mean of the Bar. at noon. | Diurnal mean of the Bar. at 9 P. M. | Rain in 1832. | Rain in 1831. | Average of the 3 years. | Prevailing Winds. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| January,.... | 62,8 | 70,0 | 29,80 | 29,79 | ,165 | 0 | ,55 | N. W. | First two days cloudy, rest clear, sometimes variable airs. |
| February,... | 67,9 | 74,5 | ,73 | ,66 | 1,275 | 3,000 | 1,425 | W.S.W. | Mostly cloudy, heavy raining on the 16th. |
| March,..... | 72,1 | 80,0 | ,69 | ,66 | 3,341 | 1,642 | 1,787 | W.N.W | Variable weather and winds, heavy hail storm all round on 24, 25, and 26 ; stones said to weigh 1 chittack each. |
| April,...... | 82,8 | 88,5 | ,64 | ,60 | 1,162 | 4,397 | 2,643 | W. | Mostly strong southerly winds on surface, cloudy with strong heat at times, and heavy storms on the 24th and 30th. |
| May,....... | 84,5 | 91,3 | ,53 | ,48 | 4,021 | ,340 | 3,329½ | W. | Transit of Mercury over sun at 6 P. M. cloudy, strong South and Easterly winds till 21st, afterwards strong heat and winds, on the 11th heavy rain with strong gale, thunder and lightning. |
| June,....... | 87,7 | 94,0 | ,35 | ,350 | 5,335 | 15,989 | 9,974½ | W. | Rains set in, on the 24th cloudy, variable winds and hot before that date. |
| July,....... | 84 | 88,6 | ,378 | ,370 | 12,225 | 10,987 | 12,904 | E. | Very heavy showers with thunder and lightning during the month, but partial in the neighbourhood. |
| August,..... | 83 | 87,0 | ,337 | ,347 | 16,571 | 11,286 | 11,588½ | W. | Heavy rain with squalls, only 7 days without rain during this month—heavy thunder and lightning. |
| September,.. | 83 | 88,0 | ,508 | ,522 | 8,283 | 10,259 | 7,775 | W. | 12 fair days, heavy showers on most of the remainders, with thunder and lightning. |
| October,.... | 79 | 85,0 | ,640 | ,651 | 5,222 | 5,854 | 4,249½ | N. W. | Severe gale for 6 hours on the 7th, with heavy rains, heaviest part of it passed to the eastward about 50 miles off. |
| November,.. | 72,3 | 78,9 | ,812 | ,791 | ,115 | 4,460 | 1,846 | N. W. | Fine weather with sultry days, occasionally some specks. |
| December,.. | 64,5 | 70, | ,745 | ,723 | 0 | 1,438 | ,479 | N. W. | Ditto ditto Occultation of planet Venus with the Moon 25th, at 10 minutes after 8 P. M. |
| Averages,... | 76,9 | 82,1 | 29,596 | 29,578 | 57,715 | 69,652 | 58,057 | W.N.W. | |

Fall of the Barometer, 7th Oct. 1832,............0.480 inches.
Ditto,.... .......... 31st Oct. 1831,...........0.700 ditto.
Rain fell,.............7th Oct. 1832,...........3.895 ditto.
Do. do. ..........31st Oct. and 1st Nov. 1831,..4.460 ditto.

*Meteorological Register, kept at the Assay Office, Calcutta, for the month of July, 1833.*

| Day of the month. | Barometer reduced to 32° Farh. At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Thermometer in the Air. Minimum at 5 A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | Depression of moist-bulb Thermometer. At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | Hair Hygrometer. At 10 A. M. | At 4 P. M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ,500 | ,584 | ,480 | ,511 | 80,5 | 86,7 | 92,3 | 90,0 | 85,3 | 3,4 | 3,8 | 7,0 | 3,0 | 96 | 90 | 0,74 | o. | s. | s. e. | haze. | clear. | c. cirri. |
| 2 | ,451 | ,500 | ,428 | ,508 | 83,2 | 87,8 | 94,0 | 90,2 | 79,7 | 5,2 | 6,1 | 6,4 | 2,4 | 91 | 91 | | o. | s. | s. | scud. | do | rain. |
| 3 | ,485 | ,555 | ,464 | ,533 | 81,4 | 86,2 | 90,2 | 88,3 | 81,8 | 2,3 | 4,5 | 3,8 | 6,1 | 94 | 98 | 0,25 | s. | s. | s. w. | nimbi. | cum. | do |
| 4 | ,488 | ,535 | ,487 | ,530 | 80,1 | 85,7 | 90,4 | 85,0 | 77,2 | 2,9 | 3,4 | 4,8 | 2,8 | 96 | 95 | 0,92 | s. | s. | o. | do | fair. | do |
| 5 | ,506 | ,526 | ,454 | ,539 | 78,5 | 83,4 | 90,4 | 87,5 | 84,0 | 2,4 | 4,2 | 4,4 | 3,2 | 98 | 95 | 0,56 | N. | S. | o. | storm. | rain. | clear. |
| 6 | ,478 | ,594 | ,432 | ,549 | 82,5 | 86,2 | 95,0 | 86,1 | 80,0 | 1,8 | 4,5 | 4,2 | 2,2 | 94 | 96 | | o. | o. | o. | cir. strat. | cum. cir. | do |
| 7 | ,518 | ,609 | ,528 | ,567 | 79,5 | 85,4 | 91,6 | 87,2 | 83,0 | 2,5 | 4,2 | 5,0 | 4,6 | 94 | 93 | | s. e. | s. e. | o. | stratus. | showery. | do |
| 8 | ,552 | ,534 | ,507 | ,539 | 81,0 | 86,5 | 92,4 | 90,5 | 82,5 | 2,0 | 5,1 | 7,2 | 4,3 | 93 | 90 | 0,15 | o. | s. w. | s. | cir. strat. | fair. | do |
| 9 | ,499 | ,504 | ,435 | ,514 | 82,2 | 88,2 | 96,7 | 91,3 | 85,8 | 3,1 | 5,7 | 8,6 | 5,6 | 92 | 84 | | s. e. | s. | S. | clear. | do | do |
| 10 | ,470 | ,508 | ,435 | ,488 | 82,0 | 89,7 | 98,0 | 93,5 | 86,1 | 3,0 | 6,0 | 8,8 | 5,8 | 92 | 86 | | s. | s. e. | s. e. | do | do | do |
| 11 | ,461 | ,508 | ,452 | ,516 | 83,1 | 89,7 | 98,0 | 90,4 | 85,0 | 2,7 | 6,8 | 6,0 | 4,0 | 92 | 93 | 0,52 | o. | s. | s. e. | do | showers. | do |
| 12 | ,476 | ,528 | ,435 | ,554 | 83,0 | 88,7 | 92,5 | 87,8 | 84,0 | 1,8 | 5,0 | 4,5 | 3,2 | 93 | 95 | 0,52 | o. | e. | e. | nimbi. | thunder. | cum. |
| 13 | ,450 | ,490 | ,417 | ,472 | 82,0 | 86,8 | 92,0 | 87,7 | 83,2 | 2,0 | 3,5 | 3,8 | 2,4 | 96 | 97 | 0,18 | o. | s. e. | s. e. | do | overcast. | thunder. |
| 14 | ,422 | ,493 | ,431 | ,483 | 78,1 | 86,1 | 87,4 | 87,2 | 83,8 | 0,1 | 3,7 | 3,5 | 3,8 | 97 | 98 | 0,34 | s. | n. | s. | rain. | do | nimbi. |
| 15 | ,439 | ,526 | ,467 | ,539 | 82,1 | 85,5 | 89,0 | 87,4 | 84,2 | 1,6 | 3,0 | 3,6 | 2,9 | 98 | 96 | 0,38 | o. | o. | s. | nim. | cum. | overcast. |
| 16 | ,482 | ,549 | ,470 | ,546 | 80,0 | 85,6 | 91,2 | 85,6 | 82,5 | 1,9 | 3,3 | 3,5 | 1,5 | 96 | 98 | | o. | s. | s. e. | cum. | do | rain. |
| 17 | ,525 | ,574 | ,500 | ,548 | 78,4 | 85,4 | 90,0 | 87,8 | 84,1 | 0,2 | 3,3 | 4,5 | 3,4 | 96 | 94 | 2,10 | o. | s. | s. | rain. | do | clear. |
| 18 | ,515 | ,564 | ,472 | ,497 | 84,2 | 85,2 | 90,0 | 84,8 | 81,8 | 3,5 | 3,4 | 3,2 | 2,0 | 97 | 97 | | s. | s. | o. | overcast. | fair. | rain. |
| 19 | ,479 | ,548 | ,479 | ,548 | 83,0 | 83,4 | 90,0 | 83,7 | 83,2 | 3,0 | 2,5 | 3,0 | 2,4 | 98,5 | 97 | 1,54 | o. | s. w. | S. | cir. cum. | do | clear. |
| 20 | ,497 | ,571 | ,494 | ,547 | 82,0 | 84,9 | 89,3 | 84,5 | 80,0 | 1,3 | 2,4 | 3,0 | 1,8 | 99 | 96 | | o. | s. | S. | cir. strat. | do | hard rain. |
| 21 | ,503 | ,552 | ,475 | ,538 | 80,0 | 83,2 | 87,8 | 85,8 | 82,0 | 2,9 | 3,0 | 3,0 | 3,0 | 98 | 96 | 2,14 | S. | S. | S. | rain. | do | clear. |
| 22 | ,500 | ,558 | ,461 | ,519 | 80,2 | 83,0 | 91,6 | 87,5 | 82,7 | 2,0 | 2,8 | 3,7 | 3,0 | 98 | 96 | 0,10 | n. e. | S. | s. | nimbi. | clear. | do |
| 23 | ,529 | ,558 | ,487 | ,567 | 81,2 | 85,4 | 92,1 | 88,5 | 84,5 | 3,9 | 3,5 | 3,7 | 4,8 | 97 | 92 | | NE. | E. | E. | clear. | do | cum. |
| 24 | ,502 | ,564 | ,458 | ,559 | 82,0 | 86,5 | 91,8 | 89,5 | 82,0 | 3,3 | 4,3 | 3,5 | 1,2 | 94 | 90 | 0,08 | E. | s. e. | S. E. | cum. | do | clear. |
| 25 | ,521 | ,571 | ,476 | ,540 | 80,0 | 86,8 | 92,3 | 87,8 | 83,1 | 1,8 | 4,0 | 4,0 | 3,1 | 95 | 94 | 0,60 | s. e. | E. | E. | clear. | do | stratus. |
| 26 | ,503 | ,546 | ,465 | ,523 | 81,0 | 86,4 | 91,8 | 88,5 | 84,3 | 1,6 | 4,5 | 4,4 | 3,3 | 94 | 95 | 0,06 | E. | E. | E. | nimbi. | showers. | clear. |
| 27 | ,489 | ,538 | ,446 | ,517 | 80,3 | 87,2 | 91,5 | 90,0 | 84,1 | 2,1 | 3,6 | 6,4 | 3,0 | 96 | 92 | 0,86 | S. | s. e. | S. | rain. | clear. | scud. |
| 28 | ,485 | ,525 | ,434 | ,483 | 82,2 | 87,7 | 93,2 | 88,8 | 85,7 | 1,2 | 4,5 | 4,2 | 3,2 | 94 | 95 | | o. | s. e. | S. | clear. | cum. | stratus. |
| 29 | ,441 | ,460 | ,384 | ,463 | 83,2 | 88,3 | 93,8 | 87,4 | 84,2 | 2,2 | 4,5 | 4,5 | 2,4 | 95 | 95 | | o. | s. w. | s. | do | threatning | c. cum. |
| 30 | ,415 | ,454 | ,376 | ,439 | 83,2 | 88,6 | 94,0 | 87,4 | 83,2 | 2,2 | 4,4 | 3,8 | 2,8 | 95 | 95 | | s. e. | N. | E. | stratus. | cloudy. | do |
| 31 | ,419 | ,433 | ,419 | ,509 | 82,0 | 85,3 | 85,2 | 86,0 | 80,0 | 2,2 | 2,6 | 3,2 | 1,2 | 98 | 97 | | o. | N. E. | S. E. | haze. | hard rain. | all day. |
| Mean | ,484 | ,533 | ,454 | ,522 | 81,3 | 86,3 | 91,8 | 87,9 | 83,0 | 2,3 | 4,0 | 4,6 | 3,2 | 95,4 | 94,0 | 12,44 | calm and variable | | | moderate rainy. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory, of which the windows are generally open. The Instruments for 5 A. M. and 3 P. M. are observed daily in the south veranda of a house near the Cathedral. The proper corrections for the several Instruments used will be furnished at the conclusion of the year.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## No. 20.—*August*, 1833.

### I.—*Origin of the Shákya race, translated from the* ལ *(La), or the* 26*th, volume of the* mDo *class in the Ká-gyur, commencing on the* 161*st leaf. By* M. Alex. Csoma de Körös.

On a certain occasion, when Shakya (in the text སངས་རྒྱས་བཅོམ་ལྡན་འདས *Sangs-rgyas* b*chom*-l*dan* h*das ;* Sanscrit, *Buddha Bhagaván)* was in the *Nyagrodha* grove (S. *A'rama*), near *Ser-skya Gzhí* (S. *Capilavástu*), many of the *Shákyas* that inhabited *Capilavástu* being gathered together in their council-house, questioned one another, saying ; *Shès-dan-tak !* (ཤེས་ལྡན་དག, "intelligent ones :" an address.) "Whence sprang the *Shakya race?* What is their origin? What is the cause or reason thereof? And what is the ancient national descent of the *Shákyas?* If any one should come to us, and ask us about those points, we could not tell him whence the *Shákyas* originated. Come, let us go to *Bhagaván* and ask him on the subject, that we may abide by his saying."

Thereupon a very great number of the *Shákyas* inhabiting *Capilavástu*, went to the place where Bhagava'n (b*chom*-l*dan* h*das*) was, and after having made their salutation by prostrating themselves at his feet, sat aside.

Having addressed him by this term བཙུན་པ, b*tsun-pa* (Venerable Sir !) they repeat again, how they had been assembled, on what subject they had talked, and how they had resolved to come before him ; and then they begged of him, that he would acquaint them with those things that they might afterwards tell them to others.

Bhagaván thinking that, should he himself tell the history of the ancient national descent of the *Shákyas*, then the *Tirthikas* and

*Parivrajakas* (or they that are not of his followers) would say, that Gautama tells whatever he pleases, to praise himself and his tribe. Not to give them an opportunity for using such expressions, he reflected within himself who were there among his disciples, who could tell, in an instructive manner, the ancient descent of the *Shákyas.*

Perceiving Mongalyana to be present, and judging that he was a fit person for that purpose, he called on him, saying, " *Mongalyana,* I am somewhat indisposed (I feel some pain in my back), and want repose; be you empowered by me to tell to the priests *(Gelongs)* in an instructive manner the ancient national descent of the *Shákyas.*" He, nothing loth, assented. Shakya, seeing that he obeyed his bidding, and having folded up his cloak, and put it for a bolster or cushion, leaning on his right side, and laying his feet upon each other, with a clear knowledge, recollection, and self-consciousness, composed himself to sleep.

Môngalyana, (with the prefixed title ཚེ་དང་ལྡན་པ, S. *Ayusmán,* long-lived; *Ayusmán Môngalyana,)* in order to collect his ideas on the subject, entered into a deep meditation, wherein he saw the whole story. Recovering from his ecstasy, he sat down on a carpet, spread on the ground, in the middle of the priests. Then he addressed the *Shákyas* of *Capilavástu,* in the following manner:

" *Gautamas!* (or descendants of *Gautama,* གཽ་ཏ་མ་དག). When this world was destroyed, the animal beings (སེམས་ཅན *Sems-chan,* Sanscrit *Satwa*), mostly were born again amongst the gods, in that division of the heaven, which is called that of " clear light" (S. *Abháswára,* Tib. འོད་གསལ). And they resided there for a long period of time, having an intellectual body, perfect in all its members and limbs, of a good colour, shining by itself; they walked in the air or heaven, and their food consisted of pleasures only.

At that time this great earth was turned into mere water; it consisted of one lake or ocean. At length, on the surface of that ocean there was formed by the air a thin substance, like skim on the surface of boiled milk, that grew hard and covered the whole surface. That earthly essence was of a fine colour, odour, and taste. The colour like that of fresh butter; the taste like that of refined honey. Descendants of *Gautama!* Such was the beginning of this world.

Then, some animal beings in *Abháswára,* having finished their lives, were born again to taste of the condition of man, and came to this earth. They were with a perfect body produced from the mind (or they had an intellectual body), having all their members and limbs entire; they had a fine colour, and they were shining by themselves; they walked in the air or heaven, and fed on pleasures only; they lived for a long period.

There was at that time in the world no sun, no moon, no stars, no distinction of time, no moment, no minute, no night and day, no month and year. No distinction into male and female sex. They were called all by this one name, Animal (སེམས་ཅན *Sems-chan.)*

Afterwards an animal being, of a covetous nature, tasted with his finger's top of the earthly essence *(Sahi-b,chud* སའི་བཅུད), and the more he tasted the more he liked it, and the more he liked the more he ate thereof, till by little and little he ate a mouthful. Other animal beings having observed him, they likewise did the same.

When those animal beings had eaten, successively, each a mouthful, then entered into their bodies solidity and heaviness. The brightness of their colour vanished, and then arose darkness in the world. *Gautamas!* After there had morally arisen darkness in the world, the sun and moon appeared, and so the stars also, and the distinction of time into moment, minute, night and day, month and year, began. They passed thus a long time, living on that essential food. They that had eaten but little of that food were possessed of a fine complexion or colour, they that had eaten much became of a bad colour. And so from the measure of food, there arose among them two species of colour. "Ha! Animal being! I have a good colour, thou hast a bad colour;"—thus spoke contemptuously one animal being to another. On account of the sin of such proud talk with respect to colour, that earthly essence disappeared.

*Gautamas!* The earthly essence having disappeared, the animal beings, gathered together, uttered many lamentations, and recollecting what a fine flavour it had, regretted much the loss of that substance.

*Gautamas!* After the earthly essence of the animal beings had vanished, there arose from the earth a fatty substance of a fine colour and taste. They lived for a long time by eating of that substance. They that ate but little of that food were possessed of a good complexion or colour; they that ate much became of a bad colour. And thus from the measure observed in eating, there arose among them two species of colour. "Ha! Animal being! I have a good colour, thou hast a bad colour;" thus contemptuously addressed one animal being to another animal being. On account of the sin of pride, again, the fat of the earth disappeared.

*Gautamas!* The fatty substance of the earth having disappeared, the animal beings gathering together, uttered lamentations; and recollecting what a fine flavour it had, they regretted much its loss: but they could not tell in words their sentiments.

*Gautamas!* After the greasy substance of the earth had vanished, there arose a sugar-cane plantation, of a fine colour, odour, and taste. The animal beings passed afterwards a long time by living on that food, until the same cause led to its disappearance.

*Gautamas!* After the sugar-cane plantation had vanished, there came forth clean and pure *sálu* (rice), without being ploughed or sown, having no straw, no husk, no chaff; if cut in the evening it ripened again till the next morning (or there was every evening and morning ready a fresh crop). The animal beings passed a long time living on *sálu*.

From the use of that fruit there arose the distinction of sexes. Some of the animal beings became males, and some females. The different sexes regarded each other with fixed eyes. The more they regarded each other, the more they became affectionate and desired each other. Being observed by others, they were reproached by them for their actions, and hated. They threw on them stones, clods, &c. (in the same manner as now they use at the celebration of nuptials, to cast or sprinkle on the bride scented powder, perfume, chaplets, clothes, and parched rice, saying, May you be happy!) and reproved them much. The others, in their turn, replied, "Why do you thus abuse us now, is there no other proper time for telling us these things?"

*Gautamas!* Thus what anciently was regarded as an immoral action, is now taken for a virtue. They restrained themselves for a time (for 2, 3, or 7 days) from satisfying their lust. But afterwards not being able to contain themselves, they commenced to make some covert, or hiding place, whither they might retire from the sight of others to satisfy their lust; saying repeatedly, We will practise here what is not to be done elsewhere, and uttering, *Khyim, khyim;* covert, covert, or house, house.

*Gautamas!* This is the first beginning of building houses.

They used to gather in the evening the *sálu* that was required for the evening repast, and in the morning that which they wanted in the morning. Afterwards it happened once that a certain animal being having gathered *sálu* in the evening for the next morning also, when he was called on by another animal being to go and gather *sálu*, he said to him, O animal being, take heed to thine own *sálu*, I have brought yester-evening the *sálu*, which I require this morning. Then the other animal being reflected with himself thus; Ah well then! I shall hereafter take *sálu* for 2, 3, nay for 7 days, at once." He did afterwards accordingly as he had said. Then an animal being said to him, " Come, let us go to bring *sálu*." He then said to him, O animal being, take care for thine own *sálu*; " I for myself have brought at once, for seven days." Then that animal being reflected with himself thus, " O well, very well, I shall take at once for fifteen days—for one month." And he did accordingly. When the *sálu* had been taken thus by anticipation by these animal beings, there grew afterwards *sâlu* that was covered with straw, husk, and chaff, and when cut down, grew not again.

Then those animal beings assembled together, and reflected on their former state thus:

*Shes-dan-tak !* (ཤེས་ལྡན་དག, &c.) See leaves 168, 169. [Here follows a repetition of the above described stories respecting the several changes that took place in the state of the animal beings. How perfect they were formerly, and how degenerate they are now.]

Afterwards, being gathered together, some of them said, " We must mete out the land and assign the boundary of each property; saying, This is thine, and this is mine." Accordingly, they measured and divided the land, and erected land-marks.

*Gautamas !* This is the first time in the world that men commenced to erect land-marks. This also was a natural consequence.

It happened afterwards, that an animal being, who had his own *sálu*, took away that of another not being given to him (or stole it). Other animal beings having seen him, that, though he had his own *sálu*, he had taken away that of another, not being given him, they said thus to him, " Oh animal being! thou having thine own *sálu*, why takest thou that of another, without being given thee?" They seized him and dragged him on this and on that side, and took him into the congregation, and then reproved him thus, " Sirs! this animal being, having his own *sálu*, has taken away three times that of another without its being given unto him."

Then those animal beings said to this, thus, " Oh! animal being, thou having thy own *sálu*, why takest thou that of another which he had not given thee? Oh! animal being; go now away, henceforth do not act in this manner?" Then that animal being thus said to the others, " Intelligent beings! This animal being having dragged me on this side and on that side, on account of the *sálu*, taking me into the congregation, has also abused me (with his language)." Then those animal beings thus said to that animal, "Ha! animal being! after having dragged this animal hither and thither on account of the *sálu,* and having brought him into the congregation too, why hast thou abused him? Oh! animal being, go thou now thy way, hereafter do not thus."

Then those animal beings reflected with themselves thus, Intelligent beings! On account of *sálu,* one is dragged hither and thither, and is rebuked also in the congregation. But we should meet, and from among us we should elect one (who is of a better complexion, handsomer countenance, more beautiful, more fortunate, and more renowned) for the master and proprietor of all our fields or lands.

He shall punish from among us those that are to be punished. He shall reward those that merit to be rewarded. And from the produce of our lands we shall give him a certain part, according to a rule.

They accordingly met, and elected one for their master and proprietor of their lands, and for the arbitrator of their controversies, saying to him; "Come, animal being, punish from among us those that are to be punished, and reward those with a gift that merit to be remunerated; from all the products of our lands we will pay you a certain rate, accordingly to a rule." Afterwards on both sides, they did accordingly. Since he was carried (or honoured) by a great multitude of animal beings, he was called མང་པོས་བཀུར་བ *Mang-pos* b*kur-va;* Sanscrit, *Mahá Sammata,* "Honoured by many."

*Gautamas!* At the time of *Mahá Sammata,* man was called by this name, "Animal being."

[The following five leaves (from 171—175) are occupied with an enumeration of the descendants of Mahá Sammata down to Karna (ཉེ་བ་ཙན) at *Potala* (གྲུ་འཛིན *Gru*-h*dsin** the harbour.) He had two sons, Gotama and Bharadhwaja (T. r*Na-va-chan.)* The former took the religious character, but *Gotama* being afterwards accused of the murder of a harlot, was unjustly impaled at *Potala,* and the latter succeeded to his father. He dying without issue, the two sons of Gotama inherit, who were born in a præter-natural manner; from the circumstances of their birth, they and their descendants are called by several names; as, ཡན་ལག་སྐྱེས *Yan-lag-s,kyes;* (S. Angirasa,) ཉི་མའི་གཉེན; *Nyi-mahi-gnyen,* (S. Surya Vánsa,) Gautama, གཽ་ཏམ; བུ་རམ་ཤིང་པ *Bu-ram shing-pa,* (S. Iskhwaku.) One of the two brothers dies without issue, the other reigns under the name of Ikshwaku.

To him succeeds his son, whose descendants (one hundred) afterwards successively reign at *Potala* (གྲུ་འཛིན), *Gru*-h*dsin.* The last of

* The ancient *Potala,* or the modern *Tatta,* at the mouth of the Indus.

whom was བུ་རམ་ཤིང་པ་འཕགས་སྐྱེས་པོ: Ikshwaku Virudhaka, (or Vidéhaka.) He has four sons, སྐར་མདའ་གདོང, ལག་རྣ, གླང་པོ་ཆེ་འདུལ, and རྐང་གདུབ་ཅན. After the death of his first wife, he marries again. He obtains the daughter of a king, under the condition that he shall give the throne to the son that shall be born of that princess. By the contrivance of the chief officers, to make room for the young prince to succession, the king orders the expulsion of his four sons.

They taking their own sisters with them, and accompanied by a great multitude, leave *Potala* (གྲུ་འཛིན), go towards the Himalaya, and reaching the bank of the *Bhagirathi* river (སྐལ་ལྡན་ཤིང་རྟ) settle there, not far from the hermitage of Capila the *Rishi* (དྲང་སྲོང་སེར་སྐྱའི་བསྟི་གནས), and live in huts made of the branches of trees. They live there on hunting; and sometimes they visit the hermitage of Capila the Rishi. He observing them to look very ill, asks them why they were so pale. They tell him how much they suffer on account of their restraint or continence. He advises them to leave their own uterine sisters, and to take themselves (to wife) such as are not born of the same mother with them. O great Rishi! said the princes, is it convenient for us to do this? Yes, Sirs, answered the Rishi, banished princes may act in this way. Therefore, taking for a rule the advice of the Rishi, they do accordingly, and cohabit with their non-uterine sisters, and have many children by them. The noise of them being inconvenient to the Rishi in his meditation, he wishes to change his habitation. But they beg him to remain in his own place, and to design for them any other ground. He therefore marks them out the place where they should build a town: since the ground was given to them by Capila, they called the new city *Capilavastu*. They multiply there exceedingly. The gods seeing their great number, show them another place for their settlement. They build there a town, and call it by the name of ལྷས་བསྟན *Lhas*-bstan, (shown by a god.)

Remembering the cause of their banishment, they make it a law, that no one of them hereafter shall marry a second wife of the same tribe, but that he shall be contented with one wife.

At *Potala* (གྲུ་འཛིན) the king Ikshwaku Virudhaka, recollecting that he had four sons, asks his officers, what has become of them. They tell him, how for some offence His Majesty had expelled them, and how they had settled in the neighbourhood of the *Himálaya,* and that they have taken their own sisters for their wives, and have been much multiplied. The king, being much surprised on hearing this, exclaims several times: *Shákya! Shákya!* Is it possible! Is it possible! (or

O daring! O daring!) ཕོད་པ *phod-pa,* and this is the origin of the *Shákya* name.

After the death of Ikshwaku Virudhaka, བུ་རམ་ཤིང་པ་འཕགས་སྐྱེས་པོ at *Potala,* succeeds his younger son རྒྱལ་སྲིད་དགའ, *rgyal-srid dgah,* (he that desires to reign.) On his dying without children, the banished princes successively inherit. The three first have no issue; the son of རྐང་གདུབ་ཅན, the fourth prince, is, *Gnag-hjog,* གནས་འཇོག. His son is ས་ཁྲིམ. His descendants to the number of 55,000 have reigned at *Capilavástu.* [An enumeration of the princes who reigned at *Potala* after Ikshwaku' follows, which is indentical with the list in Sanskrit authorities; the names being translated into Tibetan according to their literal meaning; as for *Mahá Sammata, Mang pos bkur-va,* greatly honored, &c.]

Here ends the narration of Mongalyana. Sha'kya approves and recommends it to the priests.

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## II.—*Second report on the Geology of Hyderabad. By* H. W. Voysey, *Esq. Surgeon and Geologist to the Trigonometrical Survey of India, dated Secanderabad, the 28th June,* 1820.

I had the honor of submitting a geological description of part of the dominions of His Highness the Nizam to the Marquess of Hastings in June last, since which I have visited a considerable additional portion of the same country, including part of the Honorable Company's territory. I now beg leave to offer a more complete geological sketch of the country through which I have passed, embracing in a great measure the substance of the former report, but more systematically arranged.

The space included between the extreme points of my different journeys is about 3° of latitude and 5° of longitude, viz. from 16° to 19° N. lat. and from 77° to 82° E. long.: within it are four rivers, the *Godáveri, Kistna, Maujira* and *Moussa,* two of which may be ranked among the principal rivers of *India,* viz. the *Godaveri* and the *Kistnah.* The two first-named rivers take their rise in the Western Ghauts, and some of their tributary streams at their origin are only separated a few miles from each other. Their general course, is nearly south-east. The *Manjira* differs the most from that course, being forced to double on itself when it approaches the high land, commencing about thirty miles north-west of *Hyderabad.* The course of the rivers accords with that of the ranges of mountains, and the valleys through which they run.

### *Mountains.*

The granitic part of this country may be called both mountainous and hilly, and in the plains and valleys are found elevations which are miniatures of the loftier ranges. These ranges are few in number, and remarkably interrupted and irregular, their extension inconsiderable, and their height above the level of the sea about 2,500 ft., most of them falling far short of that height. Single isolated hills and groups, with round and conical summits, are by far their most common features.

Although the complete isolation of these hills and groups first strikes the observer as being the prevailing character, on a closer examination it will be found that the apparently isolated hills are connected at their base by scarcely distinguishable elevations, pursuing the N. W. and S. E. direction, common to them and the larger ones.

They are extremely bare and rugged in their outline, and consist of piles of rock, one block being heaped above the other in irregular succession on an enormous mass of concentric granite. In the process of decomposition these form tors and logging stones of a singular appearance.

The hill on which the Fort of *Bhowánigarh* is built and that of *Mául Ali,* 2017 ft. above the level of the sea, may be taken as specimens of the isolated hills and groups; and the ranges of *Mulkapur* and *Golconda* as specimens of the continued. The only parts of the country which are entitled to the name of plains are those in the neighbourhood of the rivers, being formed by their inundations and therefore of small extent.

The above description applies to the greater part of the granite country: those ranges of granite however which run N. E. and S. W. from *Guntúr* to *Gondwána,* forming the pass of the *Kistna* at *Bejwára* and that of the *Godáveri* at *Pápkunda,* are of a different character; the ranges being less interrupted, more elevated above the plains, although not higher above the level of the sea, and altogether of a different structure. Their sides are very precipitous, and oblige the traveller to use his hands and knees for a considerable portion of the ascent.

Their outline is not at all rugged, and the logging stones and tors of the former granite are nowhere visible.

The Cavalry cantonment of BA'LARA'M, six miles N. of *Secanderábád,* is one of the highest inhabited villages of the granite country, and from thence to the northward, the country gradually decreases in height as far as *Menachpet:* the same takes place more suddenly at *Malkapur* to the eastward, and at *Patancherú* to the N. W. The city of *Hyderabad,* close to the walls of which the river *Moussa* runs, is by barometrical measurement 1672 feet above the level of the sea, and the cantonment of *Secanderabad* 1837, which agrees with Colonel LAMB-

TON's trigonometrical measurement within 19 feet. Colonel LAMBTON's observatory being 10 feet high, and the house where the observation was taken between 5 and 10 feet lower than the base of the observatory, the agreement will be much closer.

The outline of the basaltic trap hills is smooth and rather flattened with a few conical elevations in the range; or they consist of an accumulation of round hills with deep ravines intersecting and separating them. They are covered with long grass to their summits. Their course is the same with the granite they cover, but it frequently happens that no regular direction can be perceived.

The sandstone country and rocks are flat, the sides of the hills steep, with extensive gaps in the course of their range, at times nearly reaching to their bases; their direction is N. W. and S. E. or nearly so, and it is probable that they extend over a considerable portion of the S. E. part of *Gondwana.*

*Rivers.*

The rivers of India, and particularly the *Godáveri* and *Kistna,* are subject to great variations in the quantity of their waters dependent on the periodical rains. The small rivers are nearly dry in the month of May, and the channels of the larger contract to a fifth from their size in the middle of the rains.

I before mentioned that the tributary streams take their rise near to each other, and pass through a country of nearly similar formation, viz. basaltic trap, and discharge their waters into the sea within 60 miles of each other by several mouths, which like those of the Nile or the Ganges run through a delta formed by their own alluvium. Their waters are much discoloured in the rains, and deposit on their banks and throughout the whole extent of the inundation, which takes place more or less every year, a thick layer of black alluvial soil, called by Europeans "black cotton soil." These banks vary from 50 to 30 feet in height, the latter being the usual height of those of the *Kistna.* About 50 miles from their embouchure they both pass through the chain of granitic mountains which extend from *Gantúr* to *Gondwána* before mentioned.

The pass of the *Kistna* at *Bejwára* is much broader than that of the *Godáveri* at *Pápkonda.* This may be the cause of the more extensive inundations of the latter, since its channel is contracted from a breadth of two and one mile to two furlongs by the lofty and precipitous sides of these mountains. This defile constitutes the S. E. boundary of His Highness's dominions. Its extent from the last Nizam's village to the nearest Company's village is about ten miles, which space is uninhabited, the banks or sides of the mountain being so steep as even to preclude communication in any other mode than by water.

The extent of the modern inundation varies from six to three miles on each side of the river, but judging from the distance at which the black alluvium is found from the banks of the river, these periodical floods have been more extensive*.

The last took place in the year 1816, and washed away houses and cattle in great numbers; and there are traditions of two others in the course of the last century, each greater than the last. I am not able to speak with so much certainty of the inundations of the *Kistna;* I have however seen the black alluvium covering the plain in which the diamond mines of *Purteál* are situated, extending six miles from its banks; also at *Shermahomedpet,* five miles N. W. of its bank.

These inundations are considered as important benefits by the inhabitants, and the produce of the land is proportionally increased after their occurrence.

*Tanks.*

The lakes I have seen are all artificial, and are found only in the granitic and sandstone country; they are usually formed by uniting two projecting points of low hills, which nearly separate the upper half of a valley from the lower, by enormous causeways of granite, or mounds of earth, which collect the different streams rushing from the hills during the rainy season, forming a sheet of water from three to ten miles in circumference.

This mode of retaining water artificially is probably coeval with the first increase of population in this country, as the small supply of water derived from wells would not be equal to the cultivation of rice, which is the only grain extensively produced in the granitic soil.

After the rains the loss they sustain from irrigation, evaporation, &c. is supplied by infiltration, nevertheless many become dry before the monsoon recommences. Those tanks which are neglected and no longer supply rice-fields are speedily covered with the large leaves and flowers of the *nelumbo indica, othelia alismoides,* and other aquatic plants: their waters acquire a noisome smell and unwholesome taste. The number of tanks and their state of repair afford a fair criterion of the prosperity of the country.

* From subsequent observations, I am inclined to believe that this alluvium or diluvium was the result of a deluge of water which found its course to the sea by the present opening of the rivers—and that they have done no more than form their beds in it.

They are less frequent in the sandstone country, and the unirrigated cultivation is accordingly more abundant.

In the basaltic trap they are rarely seen, and the irrigation of rice when cultivated is performed solely by wells.

*Hot Springs.*

There are two hot-springs. One called *Gondála* is situated in the sandy bed of the *Godáveri,* about two furlongs from its left bank, a few miles below the pagoda of *Baddrachelam.* It is covered in the rainy season by the river, but is left dry during the greater part of the year.

The bed of the river about one mile and a half wide contains granitic sand, above which appear rocks of granite and trap mixed in various ways.

The spring is situated close to these rocks. When I visited it in February, it was covered with sand, and we were obliged to dig in three places before we discovered the hottest part. Around this spot to the distance of 15 yards the temperature of a stick thrust into the ground was sensibly raised, and on digging to the depth of three or four feet, water was found hot, but of an inferior temperature to that of the central spot. Its temperature at sun rise was 139°, that of the others 120° and 130,° whilst that of the air and river was 70°. The falling in of the land, the pit being about four feet deep, so evidently reduced the temperature, that it is very probable we should have found it much higher on digging deeper, which we were prevented from doing by the inconvenience the labourers suffered from the hot-water. The presence of sulphuretted hydrogen was sensible to the smell; but the impregnation was not strong enough to blacken a silver pencil case: the tissue of a slipper was slightly discoloured on being dipped into the water.

On evaporating 2880 grains, six grains of saline matter were left behind, consisting of sulphate of soda, common salt, and muriate of lime.

It is much resorted to from its supposed efficacy in curing cutaneous disorders. It is worthy of remark, that the rocks in the neighbourhood contain no iron pyrites. Its heat therefore cannot be ascribed to the spontaneous combustion of that mineral.

On the opposite bank of the river is a bluff rock of sandstone, through the crevices of which water infiltrates and is collected in small reservoirs, caused by the continued dropping on the soft stone. Its temperature at nine o'clock was 68°. I do not consider this to be the mean temperature of the place, since its latitude, 18° N. and height above the level of the sea not exceeding 130 feet, would make its mean temperature much higher. It is called by the natives, "the cold spring," in contradistinction to its neighbour *Gondála*.

About 30 miles to the N. W. of this place is the hot-spring of *Bangah,* situated in a valley surrounded by sandstone rocks. It is a pool of water, about 40 feet long by 20 broad and five feet deep. From the deepest part a number of bubbles of air or steam are continually ascending; there its temperature is 110°, but at the sides 100°. It holds in solution a small quantity of carbonate of lime. It is surrounded by loose blocks of a porous black limestone: the water is tasteless, and remarkably pure in other respects.

I have frequently received information of the existence of springs of water both in the granite, the trap, and the sandstone countries, but have always been disappointed in my search after them; as I have invariably found that the rills which flow down to the rivers are supplied by infiltration of water through the rocks, from the higher ground, and their temperature always that of the surrounding atmosphere. This perfectly accords with the structure of the country, and the absence of rain during eight months of the year. The hills being none of them high enough to intercept the clouds, and deprive them of their water.

The temperature of a well at *Beder,* 200 feet deep, was 77° in the month of March, and that of a well, 40 feet deep, at *Secanderabad,* 78° in November and in June: this is probably very near the mean temperature of both places.

### *Soils.*

The fertility of the soils which compose the cultivated districts of the granitic part of this province would depend greatly on the facility with which the rock of which they are formed, decomposes, were not water the most important requisite in the cultivation of rice. The soil is of course siliceous, but varies as much as the granite rock itself, which will be described in another part of this sketch. Generally, it has few spontaneous productions. The rich valley of *Malkapur* forms an exception, and it may be said that usually the spontaneous fertility is in the inverse ratio of height above the level of the sea.

The following is an analysis of a garden soil at the cantonment of *Secanderabad,* which has not received much manure.

Specific gravity of soil 1·70. Four hundred and eighty grains contained; viz.

| | | |
|---|---|---|
| Of water of absorption,.................................... | 10 | grs. |
| Stones, consisting of quartz and felspar,........................ | 255 | |
| Vegetable fibre,............................................ | 2 | |
| Siliceous sand,............................................ | 154 | |
| | 421 | |

Of minutely divided matter separated by infiltration; viz.

| | |
|---|---|
| Carbonate of lime, | 7 |
| Vegetable matter, destructible by heat, | 7 |
| Oxide of iron, | 2.5 |
| Soluble matter, common salt, | 4 |
| Silica, | 20 |
| Alumina, | 8 |
| Loss | 10.5 |
| Total. | 480.0 |

The soil of the basaltic trap country is generally very retentive of moisture, and accordingly those plants which do not require an artificial supply of water are its principal productions: such are cotton, jován *(ligusticum ajwán)*, horse gram, *Zea mays, carthamus tinctorius, ricinus communis*, &c. &c.

The iron clay in the environs of *Beder* is very sterile, and is so porous that all water percolates through it to the substratum, which is basalt; from this cause it is that the wells at that place are deep.

The sandstone soil contains a considerable quantity of clay, and is retentive of moisture; irrigation is however employed for rice, and generally it may be said to partake of the nature of both the trap and granite soils.

Above all others that I have hitherto seen, that arising from the decomposition of the clay slate marked B. in the map, is the richest and most spontaneously productive.

On the tops of its mountains I saw the loftiest teak trees, and in its plains the most exuberant vegetation.

The black alluvium found on the banks of all the rivers except the *Moussa*, which takes its rise in granitic country, is of the same nature with that which covers the trap mountains from the decomposition of which it arises.

*Rocks.*

The description of the soils naturally leads me to that of the rocks, of the debris of which they are composed.

The granite is found of all shades of grey, from black to white; the most predominant is reddish grey; these colours depend upon the felspar and the mica, and on the hornblende, which often occupies the place of and accompanies the mica, and is with difficulty distinguished from it. Compact felspar of a greenish tinge is a very common ingredient, and in several places I have found carbonate of lime a constituent; the quantity, however, is generally small, and only to be detected by its effervescence in acids. A tuffaceous limestone is found throughout the granite in nests and beds; my knowledge of it is yet too limited to decide on its nature.

The granite very frequently contains angular and rounded masses of a micaceous granite, which appear to have been enclosed in it when in a fluid state; at times the edges of these masses are commixed with those of the containing rock, and at others the adhesion is so loose as to allow the mass to fall out, as the more easily decomposable matrix wears away. I have seen these masses, through the whole extent of the granite country; and it first suggested to me the probability of the contemporaneous formation of the whole.

I may here observe, that the specific gravity of these masses is greater than that of their matrix, as is also their infusibility, from the greater quantity of mica they contain.

The granite of the *Godáveri* at *Papkunda* is never in concentric layers. It contains half-formed garnets and micaceous iron ore. The felspar of some specimens has a very pearly lustre: this mineral is sometimes wanting, and the rock then consists of quartz and garnets, with a few specks of micaceous iron ore.

At *Bejwára* the granite is slaty (gneiss), with an eastern dip at an angle of 70 or 80 degrees; the felspar is more abundant. In some irregular veins of earthy carbonate of lime, I found earthy grey manganese ore.

At *Gharíbpet*, a few miles from *Palúnshah*, the rock which I believe to be a continuation of the *Kainikgíri* range and connected with the granite of the province, is a compound of mica, kyanite, garnets, quartz, and felspar. If the rock were at all slaty, its name would be mica slate; it is however not at all schistose, but a solid mass of rock three hundred feet in height, and four or five hundred in length.

*Trap veins.*

The trap veins which run through this rock constitute the most remarkable fact in its history. They consist of hornblende rock, greenstone, greenstone porphyry and basalt, containing minute crystals of felspar. They are found in every part of the granite, and have generally the same direction, nearly E. and W., with a zigzag course of various length and breadth.

Some of them have been traced fifteen or twenty miles, their breadth varying from a few feet to 100, 200 and 300; at times their edges are commixed with those of the granite: the central masses affect a rhomboidal form, which in the course of their decomposition become rounded,

In a few instances I have seen these trap rocks in beds which do not appear to have any particular directions.

This was the case in the bed of the *Godáveri* near the hot-spring, also on the banks of the river, and 15 miles inland, near *Palúnshah,* and at the foot of the micaceous rock of *Gharíbpet.*

*Sandstone.*

The sandstone varies considerably in composition and colour. Its variations however occur principally in the neighbourhood of its junctions with the other rocks. Its most common cement is lithomarge, which is also found in it in nests and beds of various sizes, and of colour both white and reddish white.

It is thus found at *Jallikara Gúdani,* 20 miles N. E. of *Ellore,* at *Chintapet,* at *Palúnshah,* at *Mangapet* and *Tyellapúram.*

At its junction with the granite to the S. E. of *Hyderabad,* twelve miles from *Thatkúr,* it would be scarcely recognized as sandstone.

It there consists of a conglomerate, containing pebbles of quartz, felspar, a few scales of mica, and rounded pieces of a rock resembling the granite of *Pápkunda,* in a cement of indurated clay strongly impregnated with iron. It soon however changes to a rock, containing grains of sand cemented by lithomarge as before described.

The rounded pebbles of quartz, in some instances, form nearly the whole of the mass. It sometimes contains septaria of a black ferruginous sandstone of a curvilinear form, which project as the rock decomposes.

A few miles to the N. W. of *Buddrachellam* commences a range of flat sandstone hills called by the natives *Vindhaya ;* they extend upwards of sixty miles on the right bank of the river.

Both white and grey sandstone were brought to me gathered at their bases.

At the junction of the sandstone with the granite at *Ramgiri* it contains crystals of red felspar and a few scales of mica. In no instance have I seen this sandstone stratified. The height of the highest flat range is about 3000 feet.

*Basaltic Trap.*

The basalt which covers the granite to the N. W. of Hyderabad at first appears only on the summits of some of the hills; the latter rock still occupying the valleys and forming the sides of the mountains. It afterwards gradually increases in extent until it covers it in all its parts, the granite re-appearing only in the beds of some of the rivers, and forming the base of some isolated peaks. It is sometimes found columnar, the columns being of all sizes, from a foot to a yard and a half in diameter, as at *Oudghir, Monegal,* &c. It varies from a very compact semi-crystalline rock, resembling hornblende rock, to a porous basalt which passes into wacken, containing stilbite, mesotype, icthyophthalmite, heliotrope, calcedony, green earth, quartz with crystals of calcareous spar imbedded, the form of which the quartz has taken, demonstrating that this mineral has been the last deposited. The wacken passes into iron clay, and in some places the basalt may be seen with the wacken and iron clay in the space of a few yards. The latter forms elevated table land at *Béder*, which is 2,359 feet above the level of the sea; it closely resembles that of the red hills at *Madras*, *Nellore*, *Singhirikunda* (in the two latter on granite), all on the sea coast, but in this instance rests on basalt. I observed in it plumb blue lithomarge, and pisiform iron ore.

On the basaltic hill of *Medkunda* I observed large masses of flint lying on the surface and deeply connected; also pieces of a siliceous stone, containing shells which had lost their carbonic acid: the external surface of these masses effervesced in acids. These shells belong to the genera *turbo* and *cyclostoma*, and living specimens are found in the beds of most of the rivers as well as on the rocks in their neighbourhood. The specific gravity of these stones varies from 1·90 to 2·00, that of the flint is 2·60. A few miles from this place I observed the same shells enclosed in small pieces of earthy limestone; they were lying on the basalt, which is here 2000 feet above the level of the sea and about 200 above the river *Manjíra*: the base of the hill being granite, and the basalt not occupying more than 100 feet.

Quartz rock occurs in the granite in beds, as at *Pitlam*, *Gazypet*, and in the environs of *Hyderabad*: the rock in the neighbourhood of the latter is elevated 40 or 50 feet above the level of the plain through which it runs; its course is north and south, and its extent about twelve miles. It contains considerable quantities of amethystine quartz, which is not pure enough for the purposes of the lapidary.

The loose masses of quartz, as well as those which appear above the surface, have a rhomboidal form. This rock runs directly opposed to the greenstone veins, and intersects three of them. I have reason to believe that the trap passes through the quartz, although I have not yet distinctly observed it, except in one instance near *Hyderabad*.

### *Clay Slate.*

The clay slate which is found to the eastward of *Hyderabad*, between *Byarám* and *Palúnshah*, is about 20 miles in breadth and perhaps 30 miles in length, with a north and south direction. One of its highest points, *Panch-bondal*, is 2600 feet above the level of the sea. The valleys contain sandstone, clay slate, and quartz rock; this latter is also found on the summits in veins and beds.

Some of the mountains exhibit marks of great disturbance: the dip of their strata is to the south-east, and on their summits the quartz rock and clay slate appear to be indiscriminately mixed. The chasms formed by these disturbances give passage to foaming cascades, the only sound which breaks the awful silence of their solitude.

The rock is generally indurated clay slate passing into flinty slate, containing drawing slate but no roofing slate.

On the banks of the *Kistna* between *Amrawatí* and *Warripilí* beyond which I have not traced it, and from *Warripilí* to within three coss of *Nacricul,* is found a limestone in horizontal strata.

When first seen it lies on the surface of the earth in large flat masses partly covered with alluvial soil; its colour varying from a dirty white to a pinkish white, from which it passes into a compact black rock which is capable of receiving a good polish. It subsequently assumes a whitish green and pinkish grey, and on the banks of the river it is found of all these colours except the black. Veins of green hornstone are found passing through it, and at times small masses of red iron ore. It contains no petrifactions.

It is well adapted for building, for sculpture, for mortar, and I believe for water cement. Large pagodas and forts built of it bear fewer marks of age than most of the granitic structures.

The town of *Dáchapilí* is entirely built of it, as well as a large pagoda and fort at *Warripilí.* The famous basso relievos of *Amrawatí,* for the first account of which we are indebted to Colonel Mackenzie, are formed from this rock.

A pure lime is obtained from numerous veins of calcareous spar on the river bank, and I conceive the black limestone contains the requisite proportion of alumina and iron for making a good water-cement.

No inland carriage is required, since it is quarried on the banks of the river, and may be carried down at all seasons of the year to *Masulipatam.*

An analysis of one hundred grains of grey slaty limestone gave

| | |
|---|---|
| Carbonate of Lime, | 84 |
| Alumina, | 8 |
| Iron, | 4 |
| Loss, | 4 |
| Grains, | 100 |

*Iron Ores.*

I have hitherto seen no ores of iron in the granite. The sandstone and iron clay are the most productive. They consist principally of earthy brown and red iron ores, poor in iron, but easily smelted. The modes of smelting are well known to be very rude, and have been frequently described*. On calculation I found that the price of their iron in its best state was double that of the best English iron at home. The ore from which the steel is produced, which goes by the name of the "Hyderabad steel," is the same with that described by Dr. Hyne in his travels in India, p. 191. I have not yet seen the process of making it, but from a specimen which I found much inferior to the English steel in hardness, I should suppose it not to be the same as the Indian *wootz* so much valued at home†.

*Diamond Mines.*

On the banks of the *Kistna* and within reach of its inundations are the celebrated diamond mines of *Golconda*. It is probable they have been so named from their being the property of the sovereign of *Golconda*, which kingdom received its name from the celebrated hill fort and city called old *Golconda*, near the modern city of *Hyderabad*.

They are situated in a plain on the left bank of the *Kistna*, formed by its alluvium, and bounded on the east by a chain of mountains running nearly north and south, on the west by the river, on the north by the granite of *Sher-Mahomed-pet*, and on the south by that of *Bezwara*. In this plain a few peaks of granite of 15 or 20 feet in height are seen rising above the surface of the black alluvium, but none are found nearer the mines than one mile and a half. The mine situated nearest the hills is two miles distant from them. These hills consist of a mixture of quartz, felspar, hornblende, and mica, the latter in very small quantity; the hills near them at *Condapilí* are of sienite approaching to greenstone, the hornblende being in the greatest proportion.

From the circumstance of these sienitic hills being surrounded by granite on all sides, I venture to suppose that they are merely a repetition of the phenomenon of the trap veins on a much larger scale, in this case forming mountains differing in their constituent parts, but not more than I have observed in other instances. The taluses of these mountains extend to a very short distance from their bases, and as I was not able to find in the rubbish of the diamond mines any substrata resembling them, Werner's supposition that these rocks, which he calls trap from the examination of specimens, were the matrix of the diamond, will prove unfounded. This receives a further confirmation from the fact, that one of the mines near *Pulíchinta* is situated on or near limestone, and the mine of *Malavilí* 20 miles south-east of *Parteal* lies on granite and is surrounded by that rock.

* See Journ. As. Soc. vol. i. p. 150. † See ditto, p. 245.

Of the six villages situated in this plain, *Parteal* is the only one in which diamonds are sought for. There even no fresh excavations have been made for many years, and the workmen have been since employed in examining the old rubbish of the former excavations. They believe, in common with the searchers for diamonds in Hindustan, that the gem is always forming in the mine, although very slowly.

The village of *Parteal* presented a striking contrast to the Company's village we had just quitted: it was in ruins, and the inhabitants ill clothed and half starved in their appearance. I afterwards visited the mines of *Antior* one mile from the *Kistna, Barthemí Pandoa,* and *Malavilí,* but in none did I find labourers.

There is still a considerable quantity of ground unopened in all these mines: indeed the sides of the excavations, which have produced the finest diamonds in the world, still remain untouched. The want of capital, and the objections of the *zemindars* to a farther encroachment on the cultivated lands, may be the causes operating chiefly to prevent farther researches, together with the fact of the cheapness and plenty of the Brazil market.

The only stone common to all the mines I have visited, and which I understood to be indicative of the presence of the diamond, is the calcareous conglomerate*.

### *Garnets.*

The garnet mine of *Gharíbpet* is situated south of *Palúnshah* about eight miles. As I advanced up the ravine, in which I noticed veins of granite and trap and sand composed of mica, garnets, kyanite, quartz, and felspar, large scattered masses of rock were strewed on each side, which had fallen from the summit. On the top of the immense mass of rock were several detached pieces, no doubt destined to fall as soon as decomposition shall have smoothed the way.

Accustomed to see garnets in mica slate in Scotland and elsewhere, I was disposed to call this rock by the same name, but I did not perceive in any one instance any thing like stratification.

I found it throughout composed of mica, garnets, kyanite, quartz, and felspar; in some specimens the kyanite was next in abundance to the mica. Veins of quartz containing kyanite were very frequent. The garnets, which were seen in great profusion on the surface of the rock, were generally of a very coarse kind, as well as those which I found strewed on the surface of the ground.

At the depth of eight or ten feet in the alluvium at the foot of the rock were found the precious garnets. The theory of crystallization

* See a paper by Dr. Voysey in the Asiatic Researches, vol. xv. p. 120.

proposed by Mr. Methuen*, and founded on experiment, will serve to explain why the precious garnets are only found in the soil beneath the rock.

I conceive that in this instance, as well as many others I have witnessed, of crystallization, the small particles of garnet are brought together by molecular attraction; and by the temperature, which is nearly constant, the moisture and superincumbent pressure, crystals of the precious stone are formed.

In this mode I have seen felspar and zeolite recrystallized, at the foot of the rocks, as well as in the alluvium they afford by decomposition.

The garnets when collected are gently pounded, and the bad ones broken: those which survive the blows are reckoned of good quality.

The cheapness of these precious stones becoming greater every day, from the quantity found in all parts of the world, and the facility and exactness with which they are imitated rendering them of smaller value; the discovery of a fresh mine is scarcely worthy of notice.

I cannot close my present sketch without expressing how much I have been assisted by the kindness of Mr. Russell, resident at Hyderabad, and of Mr. Ralph, a gentleman in His Highness' service, who was my fellow-traveller for three months in a difficult part of the country, which I might never have seen but through his aid.

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## III.—*Bactrian and Indo-Scythic Coins—continued. By* Jas. Prinsep, *F. R. S., Sec. As. Soc.*

The present plate introduces us to some of the coins of Doctor Swiney's collection already alluded to in my last communication. It is as well to premise that all order of arrangement is out of the question where new objects are every day dropping in, and where the epoch of so many of our coins is not yet satisfactorily ascertained. Thus it happens that although headed "Bactrian," the last plate, as well as the present, contains coins of other dynasties.

Dr. Swiney pursued a course very similar to that of Colonel Tod in forming his collection.—"The plan I have found most successful under favorable circumstances of locality, or where no one has already explored the same ground, (and I have followed it many years before I heard of Colonel Tod's eminent success in the same pursuit,) is this: upon the line of march I employ an intelligent servant, generally a Musulman tailor, to buy up old *pyse*, which the *banyas* in some towns are in the habit of putting aside as useless, perhaps from father to son, and which rarely

* See Journal of Science and Arts, vol. i.

see the light except on occasions of this sort. Out of some dozens procured in this manner for as many current *pyse*, a few may be sufficiently curious to reward the trouble of search. Such beautiful coins as Lieut. Burnes brought back with him from the Panjáb and Oxus are no longer to be procured in India; indeed ancient silver coins are of very great rarity compared either with those of gold or copper, and the only two Bactrian coins I have been so fortunate as to discover, were obtained out of the limits of our provinces."

I have not attempted to engrave any of the numerous sketches of his antiques which Dr. Swiney has been so obliging as to forward, but have confined myself to those of which he has sent sealing-wax impressions, or paper casts made in the school-boy fashion (but not to be despised on that account), by wrapping the coin in several folds of paper, and rubbing the exterior with a key or hard blunt point.

*Bactrian coins, Plate VIII.*

*Figs.* 1, 2, and 3, are described at pages 311 and 313.

*Fig.* 4.—A small silver coin of Apollodotus, weighing 36 grs.

*Obverse,* Head with diadem and fillets, and a neckcloth, inscription circular, close but quite distinct; ΑΠΟΛΛΟΔΟΤΟΥ ΒΑΣΙΛΕΩΣ ΣΩΤΗΡΟΣ ΚΑΙ ΦΙΛΟΠΑΤΟΡΟΣ. The introduction of the conjunction ΚΑΙ I do not remember to have seen on any other Greek coin.

*Reverse.* A standing figure of Jupiter, rudely executed, holding a thunderbolt in his right hand, raised, and a kind of shield in the left: from the arms depend two ends of a sleeve or scarf; on the right is a singular monogram, (No. 4. of the series at the foot of the plate,) differing widely from that of Colonel Tod's coin of the same king, (No. 6. of the same series.) The legend is distinct but illegible, and agrees in character with that upon many of the bull and elephant coins—(see Wilson's plates, figs. 3, 4, 31; Tod, figs. 11, 12, &c.)

The native who brought this coin to Dr. Swiney stated that it was procured by him at a town called *Kaital*, in the *Sikh* territory, not far from *Karnál.*

*Fig.* 5.—A coin of Menander, agreeing in its general features with the last; weight 34 grs.

*Obverse.* A well executed and intelligent face, with the diadem; latter part of the inscription not very distinct ΜΕΝΑΝΔΡΟΥ ΒΑΣΙΛΕΩΣ ΣΩΤΗ(ΡΟΣ?)

*Reverse.* The figure supposed to be Jupiter in the last coin appears in this rather to be Minerva wielding the bolts of Jove, or it may be a native warrior throwing a bundle of javelins or darts. The monogram (No. 5) resembles the last without the hook, (unless the hook below, as I at first supposed, forms a part of it); one half of the inscription consists of the same letters as appear on the coin of Appollodotus : it must therefore be the native title equivalent to *βασιλεως σωτηρος*.

This coin was purchased of a shroff in the bazar at *Subáthú.*

In favor of these two coins I may venture to repeat the remarks of Professor Schlegel, on the equally valuable pair discovered by Col. Tod.—"These two medals are beyond all price, as much for their admirable preservation as for their extreme rarity and their importance to history." And I shall make no apology for also translating the Professor's learned commentary on that part of the Bactrian history connected with them, at length, as much more satisfactory than a partial gleaning or plagiarism of his remarks, which so well exemplify the use of numismatology in correcting the vagaries of historians.

"In the profound obscurity which envelopes the history of Bactria, we must cull with care all that can throw the least light upon it.

"We find only two passages in ancient authors which mention king Apollodotus. Arrian, the reputed writer of the Periplus, says, Ἀφ' οὗ μέχρι νῦν ἐν Βαρυγάζοις παλαι αἱ προχωροῦσι δραχμαί, γράμμασιν Ἑλληνικοῖς ἐγκεχαραγμέναι, ἐπίσημα τῶν μετ' Ἀλέξανδρον βεβασιλευκότων Ἀπολλοδοτου καί Μενάνδρου. "For this reason even now ancient drachmæ are current at Barygaza [*Brigu-gácha* or Baroach], bearing, in Greek characters, the stamp of the kings who reigned after Alexander, Apollodotus and Menander."

The two coins now brought to light, agree better with this passage from Arrian than those of Col. Tod, on account of their exact similarity, which would allow them naturally to be coupled together in speaking of them.

"The other passage concerning Apollodotus is from the summary of the history of Trogus Pompeius, which is placed at the head of the abridgment of Justin. Prolog. lxxi.

"*Deinde, quo rege pugnante, Scythicæ gentes, Sarancæ et Asiani Bactra occupavêre et Sogdianos. Indicæ quoque res additæ, gestæ per Apollodotum et Menandrum reges eorum.*"

"The printed editions have *Apollodorum,* which was corrected by the learned and judicious Bayer, on the authority of the Periplus. This reading is now fully confirmed by a medal (two), an authentic and public monument. Vaillant and Longuerue suspected a corruption of the text, and sought to correct it in another way. They thought that the name of Apollodotus, the historian of the Parthian and Bactrian kings, had been confounded with that of a king, and Longuerue proposed to read *ex Apollodoro, gestæ per Menandrum et Eucratidam, reges eorum.* This is not correcting but disfiguring arbitrarily an ancient text; and yet the latest editor of Justin in France, M. Lemaire, recommends this unwarrantable conjecture!

"Bayer, however, while he reinstates Apollodotus, disputes his title to the kingdom of Bactria, which Col. Tod again vindicates with reason. Bayer would make him one of those Greek kings who, at that epoch, reigned separately over a part of India, such as Demetrius, son of Euthydemus. This is in the first place contrary to the text of Trogus Pompeius: for the word *eorum* applies to *Bactra et Sogdianos.* The coin confirms this refutation, for by what motive should a Greek king, not having possession of Bactria, put a legend in Bactrian characters on the reverse of his coin? I call them so, without prejudice to the question of the language to which they may belong. Certainly they are not Sanskrit: they have a strong resemblance to those on the early Sassanian medals. The credit of decyphering them is reserved for scholars acquainted with Zend and Pehlevi.

"To escape from this objection, we must suppose that Apollodotus reigned in the eastern provinces of the ancient Persian empire, south of Bactria. The medal of Demetrius, son of Euthydemus, discovered by the Baron Meyendorf, bears a Greek legend *βασιλέως Δημήτριου*; the empire of India is designated by the skin of an elephant's head with which the portrait of the prince is adorned.

"Apollodotus therefore must be admitted among the kings of Bactria. The celebrated Visconti has endeavoured to assign his probable place in Bayer's Chronological Canon of Six Kings, the dates of which are however mostly conjectural: he places him after Euthydemus" (see p. 315), "and both the authorities quoted above agree in placing him before Menander. Now Menander certainly reigned between Euthydemus and Eucratidas; but Visconti will not allow the latter to follow Menander directly: he makes a place between their reigns for Heliocles, whose name is only known from one medal bearing the inscription *βασιλέως Ἡλιοκλέους δικαίου,* and pronounced by Mionnet to be of Bactrian fabric, merely from analogy to other coins of the same locality—an argument by no means conclusive. When a coin of Heliocles shall be discovered in India or Tartary, we may grant his title to the Bactrian throne."

"It is difficult to assign the exact limits of the Indian dominions of the Bactrian monarchs, or of their contemporaries, who reigned in India itself. The ancients use the word India vaguely, and sometimes make it comprise the Persian provinces north-west of the Indus. The conquests of the Bactrians may have been made in two directions:—one, towards the east by the *Panjáb,* and onwards; the other, by following the course of the Indus. The expedition of Seleucus Nicator was directed towards the Ganges; by his treaty with Chandragupta, king of the *Prasii* (people of the East), he gave up some provinces, and received a number of elephants in exchange. It is probable that the first kings of Bactria, on declaring themselves independent, took possession of what remained of Alexander's conquests in the *Panjáb.*" [Dr. Swiney's coins confirm their domination there, as far as the presence of medals can do so.] "At any rate, the third king, Euthydemus, in his treaty with Antiochus the Great, by which treaty his independence was acknowledged, gave up all his elephants. This proves two points: first, that Euthydemus had provinces, or at least subjects in India proper; second, that his rule was not extensive, for the elephants were few in number; added to those given by Sophagasenus to Antiochus, they made but 150, whereas Seleucus received 400 from Chandragupta.

"Antiochus' expedition was brilliant, but it procured him little solid advantage beyond the acquisition of these war elephants. After his compaign against Euthyde-

MUS and SOPHAGASENUS he repassed the Indus, and returned by way of Arachosia and Carmania to the western seat of his empire." [Was it after this expedition that he struck the coin represented in fig. 2, depicting the stern of a boat of the river Indus ?]

" EUTHYDEMUS may have profited by the distance of ANTIOCHUS, and the decline of his strength, to deprive him of the provinces situated along the Lower Indus. It is certain that DEMETRIUS reigned there, I think, first as governor in the name of his father ;—afterwards as an independent king. DEMETRIUS did not succeed EUTHYDEMUS in Bactria : his absence perhaps allowed his competitor to supplant him. If DEMETRIUS had not been in possession at the death of his father, with what force could he have conquered these vast provinces, when the army of Bactria was at the command of a rival ? It is he, no doubt, who founded the city of *Demetrias* in Arachosia, the name of which is preserved in the geographical work of ISIDORUS. Thence his dominions extended to the Delta of the Indus.

" TROGUS-POMPEIUS ascribes exploits in India to APOLLODOTUS and MENANDER ; STRABO also to the latter. Their conquests then must have been towards the *Panjáb,* since they would have come into contact with DEMETRIUS on the south ; and there is no mention of war between the Bactrians and this king of India until the end of the reign of EUCRATIDAS. STRABO says expressly that MENANDER passed the *Hyphases* and penetrated to the Jamna. [Εἴγε καὶ τον Ὕπανιν διέβη προς ἕω, και μέχρι τοῦ Ισαμου προῆλθε. lege Ὕασιν et Ιωμανου.]

" This authorises our extending his kingdom to *Mathura* or even *Baitasor*, (where Col. TOD's coin was found.) The probability is, that it included the kingdom of *Lahore ;* for since STRABO says that MENANDER was *the first* to penetrate so far, his predecessor's rule of course must have been more limited."

PLUTARCH bears testimony to the excellent character of MENANDER as a sovereign ;—"a certain king, MENANDER, who had reigned with justice over the Bactrians, having died *in camp,* the cities in common had the care of his funeral rites, but afterwards contended for his ashes ; they at last divided his remains equally amongst them, and agreed that monuments to him should be raised amongst them all*." May not this singular passage have had its origin in a confused account of the monuments raised by the Buddhists to preserve the relics of their lawgiver, of which one at *Manikyala* seems to have been founded immediately after the Bactrian monarchy was upset, and while the communication of those countries with the west was still perhaps maintained† ? But to return to M. SCHLEGEL's epitome :—

" We know nothing of HELIOCLES, if indeed he ever reigned in Bactria. But as EUCRATIDAS was the first to assume the distinction of *great king*, it is natural to suppose that he aggrandized the empire. He may have conquered *Ariana,* which SRABO says belonged to Bactria.

" For the war between EUCRATIDAS and DEMETRIUS, king of India, we are reduced to the unsatisfactory notice of JUSTINUS, according to whom DEMETRIUS was the aggressor. EUCRATIDAS, at first besieged, and in great danger, saved himself by his valour, and finished by despoiling his adversary. In his retreat,

* Major Tod on Bactrian Medals, Roy. As. Res. I. 330. † See page 315.

after terminating this war, he was assassinated by his son. Bayer thinks that this Demetrius is the same who in his youth negociated the peace for his father Euthydemus with Antiochus. However, the great age to which he must have attained is a staggering objection. One may reconcile probabilities by supposing that a son of the same name had succeeded to Demetrius's throne.

" The existence of the parricide of Eucratidas is well established ; but his name is unknown, and it is uncertain whether he enjoyed the fruits of his crime. King Eucratidas II. therefore,in Bayer's catalogue, rests only on a double conjecture.

"Thus end the Bactrian kings hitherto known. The latter history of the dynasty is enveloped in darkness yet thicker than the rest. Justin attributes its destruction to the Parthians; the author of the summary of Trogus-Pompeius to the Scythians ; both quoting the same authority. It appears then that both these nations took part in it, but that the Scythians remained in possession.

" In a fragment of Diodorus, or rather in an extract by Photius,it is said, that one of the Arsacidæ (no doubt the Sixth, Mithridates I.) penetrated as far as India and seized the kingdom of Porus, i. e. of the country between the Hydaspes and the Acesines. Bayer says with reason that the Greeks, wherever they allude to India, imagine a Porus ;—but in this case the historian seems justified, for we see that the Bactrians possessed not only that province but even beyond it. By Bayer's calculation, Mithridates I., king of Parthia,must have survived Eucratidas by seven years,but these dates are purely conjectural. At any rate, it is after Eucratidas' death that these conquests must have been made : the war between him and Demetrius would not have taken place had the Parthians occupied the intervening provinces. Eucratidas was assassinated when in the height of his power :—it is then after his death that the decline of the empire commenced. M. Deguignes, from the Chinese historians, fixes the epoch of its destruction in the year 125, B. C. The king or kings who may have reigned in the interim are yet unknown—perhaps they may be brought to light by Col. Tod's discoveries."

The above condensed and critical sketch of the latter Bactrian kings contains all that is known of them, and leaves us to fill up blanks only as fresh matter may be elicited through the labours of the antiquarian in this fruitful field. M. Schlegel felt pride in adding two cognomens to his two kings : Dr. Swiney's coins have already increased their majesties' titles; giving to Menander the common appellation " saviour;" and to his predecessor, in addition to the same title, the respectable appellation of Philopator, " loving son." This latter title is of more consequence than might at first be suspected, for unless his father were of kingly dignity, he would not have been mentioned : and it is more than probable that his son succeeded him peaceably. But we have no knowledge who the father was, since Demetrius is the only recorded son of Euthydemus. We may suppose him to be sure a brother—perhaps a younger one,—a favorite—" a gift of the gods," as his name implies; and this might account for the deputation of the rightful heir to a distant province : but it is wrong to hazard conjectures upon points of such remote diplomacy !

*Figs.* 6 and 7.—Two square copper coins resembling in form fig. 7 of plate VII. weight 102 and 121 grs.

*Obverse.* A figure, apparently female, holding a cornucopia on the left arm: the other indistinct; legend in parallel lines, and evidently Greek, but only partially legible: the word ΒΑΣΙΛΕΩΣ commences both of them.

*Reverse.* The Indian Bull with its hump, encircled with the unknown character. Below, in both coins, the letter sigma, Σ, or a symbol of that form.

One of these coins was found at *Machwarra,* a small town near the *Satlej* river, between *Ludiána* and *Rúpar;* the other in the bazar at *Bussy,* on the road from thence to *Simla.* Dr. Swiney considers them to be not only similar, but of the same die. It is not possible to do more than ascribe them to the Bactrian dynasty generally.

*Fig.* 8.—This small copper coin, from the neighbourhood of Seharanpúr, is classed among the Bactrian coins by Dr. Swiney, from the similarity of its monogram to that of fig. 4. The legend also appears Greek: the obverse has a warrior with a bow? and the reverse a lion, panther, or *singh,* which connects it with one class of the Hindu coins.

*Figs.* 9, 10.—I have introduced these two of Doctor Swiney's Bactrian-horsemen, or Eucratides,' coin*, because the head is in better preservation than usual, and a letter or two more of the legend can be added to the scanty list hitherto elicited; thus on fig. 9, we have ΣΩΤΗΡ ΜΕΓΑ .. and on the other ΜΕΓΑ ΒΑϹΙΛΕΥϹ, "the great king," quasi *Mahá Raja.* As far as the specimens hitherto discovered can prove it, the nominative seems to be used in all the coins of this type, instead of the genitive, as usual on Greek medals: the terminations are also corrupted; all which circumstances tend to pronounce these coins to belong to the last princes of the race, as conjectured in ascribing them to Eucratides.

*Fig.* 14, is a small coin supposed to have Greek characters, but undecypherable.

*Figs.* 16, 17, 18, are drawings of three small copper coins procured by Lieut. Burnes at *Manikyála,* which differ in some particulars from those already made public, and are on that account, rather than as leading to any fresh observation, now inserted. Fig. 16, belongs, from the side figure of the female, stooping, and the monogram or symbol, to the *Ka-*

* See Plate VII. and page 314.

*niska* group. Fig. 18, a man sitting dressed in the Brahmanical *dhotí*, accords so far with No. 1 of Mr. Wilson's plate, a gold coin dug out of the tope at *Manikyala* by General Ventura. Fig. 17, is of a novel type, but the coin was in too imperfect a state to permit an accurate development of the figures.

*Hindu Coins.*

From the coins of Bactria a transition is easily traced through the dark period of the Indo-Scythian or Buddhist dynasty, to which numerous coins have been allotted upon such degree of internal evidence as their appearance affords, to the coins of the Hindu Princes of Central India, *Andhra, Rajputana, Kanouj, Indraprestha*, and perhaps *Magadha* or Behar. I have on a former occasion ventured to doubt* whether any native coin, properly so called, had circulation in India anterior to the incursion of Alexander. In none of the ancient books† of the Hindus is mention made of coined money. The word *suverna*‡ or gold, which occurs frequently in the *Purános*, is supposed to mean a lump of gold of a fixed weight, such as is still current in Ava or China. Mr. H. T. Colebrooke states§ on the authority of Menu and other authors, that the *suverna* (*carsha, arsha*, or *tolaca*) was equal to 16 *mashas*. If the *masha* was as now about 17.4 grains only, this would certainly make the *suverna*|| small enough to admit of a doubt whether it did not bear some stamp: on the other hand, small lumps of gold called *phátang*, of a smaller weight and value, and without stamp, are still brought from the hills, and passed as cash in the purchase of goods in the plains. Again, the great analogy which is observed between the earliest Indian coins introduced to our notice by modern research, and those of the Macedonian colonists, is a very strong argument in favor of the supposition that the art of die-cutting was introduced at that period; and the employment of Greek workmen may reasonably account for the continuance of Greek legends where otherwise they would have been little expected. A further direct and incontestable proof of their connection is derived from the similarity of the

* Journ. As. Soc. I. 394.

† The Raja Taringini, a comparatively modern work, mentions the *dinar*, a Persian gold coin.

‡ As. Res. V. 93.

§ See Mr. Ravenshaw's note, page 266.

|| Major Wilford, and many as inveterate etymologists, might have derived our English *sovereign* from this word, had it chanced to have been current at an earlier period than is assigned by our mint annals for its introduction, namely, Edward IV.'s reign, A. D. 1489.

monograms or symbols visible upon most of them. I have inserted at the foot of the present plate such of these as occur in the coins before us. Most of them may be found on the Greek civic coins of the Hunterian cabinet at Glasgow; those upon the genuine Greek coins are evidently cyphers or compounds of Greek letters; either numerals marking the date, or initials of persons connected with the mint.

*Monogram* 1 appears upon a coin of DEMETRIUS of Syria (plate v.), and may be compounded of A T, symbolical of Antioch, the place of coinage: it is No. 67 of COMBE's Hunterian Catalogue. *Mon.* 2, on ALEXANDER's coin, (53 of COMBE,) may be A, and may stand for one of the numerous cities of this monarch's name. The third, (plate vii, fig. 1,) is evidently formed of the Greek letters P E, being perhaps the date (105 of the Syrian æra, or 206 B. C.)*, subjoined by A, betokening the locality. The next four (4, 5, 6, 7) occur in the coins of APOLLODOTUS and MENANDER (86, 216, and 326 of COMBE). Colonel TOD supposes the latter two and fig. 9 to be formed of numeral letters, but the combination of units is pronounced to be inadmissible. 8 and 9 appear on the coin of the last Bactrian monarch, "the great king." They are not found in COMBE: but the latter may be a combination of the letters O, T, H and E. 10, 11, and 12, having four prongs and the ring below cut open, belong to the supposed Kaniska coin, and all the coins of the raja and bull, and raja and elephant type. These can no longer be interpreted as letters, though evidently imitated from the foregoing. *Mon.* 13 occurs in one of Colonel TOD's coins of the same class, with the running figure (13 of 3rd series), but it may probably be an imperfect impression of the foregoing symbol. From monogram 12 to the lozenge form of 14 is but a slight transition, and thus we pass to a wholly different class of coins, ascribed by Col. TOD to the *Pandu* dynasty, because the inscriptions are in the same character which is found wherever the *Pandu* authority existed;—in the caves, and on the rocks of *Junagur, Girnar,* on the pillar of victory in *Meywár,* and on the columns of *Indra-prestha* (Delhi) and *Prayág* (Allahabad).

These coins are decidedly the most ancient of Hindu type which are known, and yet being of pure gold they are generally in a perfect state of preservation, and the characters, though unknown, are very clearly defined; many of them resemble the Tibetan form of Sanskrit. Most of them may be recognized in the inscriptions (or descriptive titles) over the sculptures at *Mahábálipuram,* described by Mr. GOLDINGHAM

* If so, this coin should belong to ANTIOCHUS the Great, and not A. THEOS as supposed in page 312, from his cognomen *Epiphanes.*

in the As. Res. V. page 79 : and as these sculptures are said by tradition to represent the personages and acts of the *Mahábhárat*, the value of some of the letters may perhaps be hereafter recovered. In point of age the coins can only belong to the *Maurya*, the *Sunga*, the *Kanwa* or the *Andhra* dynasties of Mr. Wilson's catalogue (315 B. C. to 428 A. D.)

*Fig.* 15 is copied from a gold coin, presented to me by Captain Wade, who discovered it near *Ferozpúr* : it agrees precisely with figs. 5 and 7, of Mr. Wilson's plate; the former of which, stated to be taken from a drawing of a coin in Col. MacKenzie's collection, seems to have been reversed by the artist, to assist the engraver, and inadvertently retained in that position. Every letter of the legend is identical in the three coins. weight 120 grs.

*Fig.* 13 is from the sealing-wax impression of a coin, belonging to Dr. Swiney : it corresponds precisely with No. 6 of Mr. Wilson's plate, having the *tirsul* or trident of Siva in lieu of the bird of Vishnu.

These two coins are of the description just alluded to. They have been found at *Agra, Mathura, Ujayin, Ajmir*, and even in Bengal. Mr. Wilson possesses one found in a tank in the *Huglí* district. The mixture of emblems on these coins might almost persuade one that they were forgeries, but that no two have hitherto been seen identically the same, and it would be manifestly impossible to forge a new die for each, especially when their price is little beyond the value of the metal. The female on the *reverse* sometimes sits on a well formed chair or settee, sometimes in the Indian fashion on a lotus flower, at others like Durga on a lion* ; she holds a cornucopia in the left hand, in the right a scarf or ribband : a glory encircles her head; her left knee is bare.

The *obverse* represents a king clad in a coat of mail, and with scale armour on the legs ; where the coin is worn, (as in fig. 15,) the dress exactly resembles the modern coat and trowsers. The head dress in fig. 13 has a resemblance to the Sassanian or Persian cap. The left hand is invariably raised, as if holding a spear : the right is extended as if placing an offering on a small fire altar. This hand is more clearly defined in fig. 15, than in any coin of the class I have seen ; and it may be questioned, whether the action is not rather that of plucking a flower, for an artist would hardly represent the hand in so hot a position, were the object beneath a fire altar !

* Vide Col. Tod's plate.

As another anomaly in these coins, it may be remarked that the letters on the left of the prince, in fig. 15, are identical with the Tibetan triliteral compound སྤྱ *spy*, pronounced as *ch* or *sh*, with the inherent short vowel *a*, *spya* or *sha* ; this combination forms no word in the Tibetan language, but with the vowel sign *i* (*shi*) it would signify "generic" or "general," as སྤྱི་དཔོན *spyi-dpon* (pronounced *shi-pon*) viceroy, or governor general.

Now the Tibetan alphabet, according to Mr. Csoma Köröshy, was only formed as a modification from the Sanskrit model in the seventh century of our æra, up to which period it were difficult to conceive that the characteristic monogram of Bactria should have been preserved. The two first letters of the side inscription also resemble the Tibetan པ་ *pá*, or if the antecedent dot be an *r*, *prá*.

On the right hand, in fig. 15, is a standard resembling in some sort a Roman eagle; it is probably the Garura, or bird of Vishnu, and if so, is a proof of the connection of this coin with the ascendancy of the Vaishnava sects.

Of this peculiar class of coin, the plates in the Asiatic Researches afford numerous varieties. I now pass to another type, more recent perhaps by several centuries, but more rare than the preceding. The legends are here decidedly in the *Devanágari* character ; yet the devices still bear a near analogy to their Grecian prototypes : the horseman, the bull, the lion, the seated figure, are revived with variations of dress and attitude, but it seems to have been contrary to the feelings or taste of the country to represent the human face, or perhaps the artists found themselves unequal to the task. Mythological subjects were better suited to the Hindus. The bull of Siva, the Singh of Durga, the Garura of Vishnu ; Gunesh, Hanuman, and similar devices, predominated until the latest period in the coins of Southern India and Ceylon* ; or until the progress of Mahomedan conquest interdicted the privilege of coinage to the tributary Hindu princes.

From the desultory mode in which materials are collected for my plates, and from a wish to avoid delineating any that have already appeared in print, it is impossible for me to give a connected train of Hindu coins, and the student must refer to the plates in the As. Res. vol. xvii, for more ample information. The medley of types once collected and preserved however may eventually afford the means of a proper classification, although it cannot be attempted in the present state of our scanty knowledge.

* See plates III. IV. As. Res. XVII. and Mr. Wilson's remarks on the *Ramatankas*, *Garada-Mudras*, &c.

*Fig.* 11 is an unique coin in Doctor SWINEY's possession. I have a sealing-wax impression, from the sharpness of which I conclude the original to be of gold.

*Obverse.* A horseman mounted and holding a spear with the right hand: the horse is ornamented with trappings in the native style. A curious scroll or symbol appears in front.

*Reverse.* SIVA's bull kneeling in the attitude of the images of NANDI in the temples. He is also clothed in ornamental trappings. Above are characters which seem to form the words श्री समग्रद्देव *Sri Samagri deva* in ancient Nagari; the व written प is met with in one of the inscriptions decyphered by WILFORD, As. Res. IX. 104. No such name as *Samagri deva* occurs in the catalogues of Hindu dynasties of Central India or *Magadha,* but the import of the words may perhaps be understood as an honorific appellation, समग्र signifies "whole, entire." Were it possible that the fourth letter were an old form of न्त we might ascribe the coin to *Samanta deva,* the first of the Ajmir princes, who reigned, according to WILSON, in A. D. 500. But such a conjecture is not warrantable. WILFORD says, the titles *Sri* and *Deva* were assumed by the descendants of CARNA, as "SRI CARNA DEVA*," &c. We may therefore ascribe this coin to the *Andhra-jatiya* or *Andhra-bhritya* dynasty, some time anterior to the Muhammedan invasion.

*Fig.* 12.—Two copper coins of this die were brought by Doctor J. M. BRAMLEY, from Nipal, in a collection of the coins of that country; and I have inserted a drawing of them here, both as a fair pledge that other ancient Hindu coins are forthcoming in that hitherto unexplored region, and as furnishing some very legible characters in a class of coin of frequent occurrence, both in gold and copper. The lion or *Singha* on the reverse agrees with fig. 8: and with fig. 12 of plate vii. The sitting female figure on the obverse may be identified with figs. 1, 11, 12, 13, 14, 16, 17, and 40 of WILSON, and with the fourth series of TOD; the characters are however of a different class, the क for instance, like that of fig. 14, in the last plate, more resembles the Bengalee form ক, and is found on ancient grants and inscriptions, between the 5th and the 12th centuries. The nail-headed character is noticed by Col. TOD, as predominating in all the inscriptions of the *Mauri* Princes of *Chitore* from (*S.* 465 to *S.* 1191) *A. D.* 409 to 1135.

* As. Res. IX. page 104.

Pl. VIII

# BACTRIAN COINS.


HINDU.

MONOGRAMS.


J. Prinsep del. et sculpsit

## IV.—*Note on the Zoology of the 2nd Part of the Transactions of the Physical Class of the Asiatic Society of Bengal.*

In India, as in almost every other country of the civilized world, natural history, and more especially that part termed Zoology, has been of late years making rapid progress. And surely there is no country better situated than Bengal for becoming celebrated for the number and extent of its collections, and the rareness of the specimens which may compose them. For, fertile as may be the regions of South America in the productions of animated nature, that field has been repeatedly traversed by the most celebrated men of science in modern times; and, many well qualified and observant men, have, at different periods, favoured the world with their researches, made during a long residence on that continent. But India has not till now been viewed, by Englishmen, as the rich mine of the treasures of science it really is; and though foreign nations have sent out able naturalists to travel through the country, and to stretch forth their hands to all they could seize in their line of march; get, the very nature of a travelling zoologist's occupation is such, as to prevent him from snatching at more than a few of the gems on the surface of things. He may collect and preserve; he may take home and classify: but much is set down in haste, much is forgotten; and he cannot become the observer of nature and all her secrets: while the manners, the habits, and the various interesting points of character, only to be developed by a long and intimate acquaintance with the animals he meets, must be to him unknown. These can only be known through the labours of men, not better qualified, but more favourably situated for the matured studies of zoology than himself.

Sensible of this hiatus in the labours of travelling naturalists, lovers of natural history have established menageries and aviaries at home: to make up, so far as close intercommunion with animals in confinement can make up, for the deficiency of knowlege, felt after all had been gleaned from books and collections. But natural history must be pursued through tracks different from those of the casual observer of wild animals in foreign countries; or, of the closet naturalist, who views them in a state of degradation, with broken spirits and ruined health, the sure concomitants of slavery in the brute as in man. A true naturalist must go forth into the wilderness. He must follow the objects of his much-loved science into the depths of the forest, to their native haunts, with the intent to observe rather than to destroy: and there, undistracted by other thoughts, and elevated by the magnificent scenery around him, he beholds their caresses, or their cruelties;

their force or their stratagem; and feels that nature is now unfettered; that they, like himself, are free.

How different is the state of mind of the man so situated, from that of him who only looks through the bars of a dungeon upon the miserable animals confined within. One views nature with the eye of a classifier alone, anxious to find out some petty point of distinction, some little difference upon which to found a genus; the other with the enthusiasm of a lover. One strives to bend her to his system: the other would embrace her own; nature to him is all in all, and system but valued as an interpreter of nature.

Systems, menageries, collections, however, have their value, and that value is great. To the naturalist of nature they serve, in after-days, to recal vividly to his mind recollections of the past. To others they offer a portion of science, that otherwise they could not attain.

Mr. Hodgson, author of six of the sixteen papers in this second part of the 1st volume of the Transactions of the Physical Class of the Asiatic Society, unites the advantages of the travelling and sedentary naturalist. Fixed upon the most stupenduous mountains of the world, and in a situation of political power that rarely falls to the lot of the friends of science, he has opportunities of doing great things for that branch to which he has devoted himself. Much may fairly be expected from him; and to do him justice he certainly is not inclined to be idle.

The first of Mr. Hodgson's papers belong to Ornithology; the portion of zoological science, perhaps of all most generally attractive. The system he follows is that laid down in the 1st volume of the Zoological Journal, (a work no naturalist should be without) by Mr. Vigors, Secretary to the Zoological Society; and which, though perhaps the best devised by English naturalists, is replete with the faults of the MacLeay school. The generic divisions are sometimes founded upon doubtful or minute characters, and there is occasionally a good deal of squeezing to make them fit. Whilst, above all, there is observable in this school an affectation of perfection; a presumption of knowledge; which with the limited acquaintance with nature man must ever be confined to, appears totally unjustifiable to every one, not seduced by the language in which its views are detailed; or willing to surrender his judgment to such great names as those of MacLeay, Vigors, and Horsfield. It is however the less necessary to dwell upon this, as the circumstance has not escaped the notice and the censure of some late continental writers: by whom the system has not been estimated so highly as was contemplated by its patrons and founders.

The first bird Mr. HODGSON describes under the name of *Aquila Nipalensis;* and he has noticed the deviation from the type of the genus *Aquila,* in the lunated form of the nostrils. There is also another point of deviation in the length of the wings, which he describes as wanting three inches, or nearly one fourth of the length of the tail. In the true eagles the wings are equal in length to the tail, "leurs ailes sont aussi longues que la queue," says CUVIER; and it is therefore not improbable that this may be one of those species which form the inosculating links between differing genera. Whether or not the species be a new one, can only be decided on the authority of Mr. HODGSON; for he has omitted to state the changes which take place in its plumage, during its passage from the young to the adult state; or the probable age of his specimen. And without these points being ascertained, the most experienced ornithologist may be mistaken in birds of this tribe.

The *Circætus Nipalensis* is rightly referred to that genus. It is not probable that SHAW has erred in placing the *Falco Bacha* in the genus *Cymindis;* distinguished as that genus is from all others of the eagle kind, by the remarkable characters of its bill. However the *Falco Bacha* is said to have been found in India and Java, and Mr. HODGSON's description of his bird agrees with it in several respects: nor is it unlikely that an African species should also extend to India. But then the difficulty still remains as to its being placed by SHAW in the genus Cymindis; with the generic characters of which, Mr. HODGSON justly says, it does not at all agree.

Our author, like all others who have gone before him, seems to be a good deal puzzled with the family of *Laniadæ* or *Laniidæ,* as it is termed in his paper. The genus *Dicrurus* was instituted by M. VIEILLOT on account of the forked tail of the species known to him. But the danger of giving a generic name on so trivial a distinction, soon became manifested, by the discovery of other species whose tail is not forked. This, among other things, has contributed its portion to throw the family into confusion. And Mr. HODGSON, or any other naturalist, would do a signal service to the cause of natural history by making a complete monograph of the whole *Laniadæ:* and (the measure is a strong but necessary one) fixing the old names or new-naming every species.

The other bird mentioned, "which bears a strong general but not particular resemblance" to the former, appears to be the same species as one sent to the Asiatic Society from Midnapúr by Assistant Surgeon J. T. PEARSON, in February 1830, and which he also referred to the genus *Dicrurus.* "I am of opinion," says Mr. PEARSON in a note accompanying some specimens presented to the Society, "that it may be referred to the genus *Dicrurus,* near to the *Muscicapidæ ;* and this not only from the form of the head and bill; but on a careful examination of the feathers at the back of the neck, a few long ones may be found, more like hairs than feathers, with a small plume at the tip." Mr. HODGSON has forgotten to mention these setaceous feathers; but they may readily be found in the situation indicated by Mr. PEARSON.

After all, however, the bird in question, the slate-coloured shrike, seems to be an intermediate species, between *Dicrurus* and *Tricophorus ;* the strong dentated bill, and short medial setaceous feathers connecting it with the former, and the wedge-shaped, or rounded tail, with the latter genus. It may be observed that Mr. PEARSON is inclined to think the species a migratory one at Midnapúr.

In his paper on this subject of migration* Mr. HODGSON remarks:

"I am led to conclude from what I have observed here, that the mass of the *Grallatores* and swimmers are found in the plains of *India,* only during the cold months, for they all arrive in the valley of *Nipal* from the north, towards and at the close of the rains; and all as regularly reappear from the south, upon, or soon after the accession of the hot weather."

Further on, he says,

"It will be noticed that the *Grallatores* which visit us or pass over us, are much more numerous than the *Natatores;* and, unless I am mistaken, observation in the plains of India would satisfactorily prove that this is a just and decisive indication of the superior prevalence of wading over swimming birds in that extensive region. India, I fancy, is too hot for the taste of the *Natatores,* a great majority of which seem to affect Arctic regions, or at least, high latitudes: I throw out the remark for canvas and inquiry."

This observation is agreeable to what we learn of the manners of these birds in high northern latitudes: and the hint should be taken by some cis-Himálayan naturalist, who will find the inquiry suggested, an interesting and not very laborious one. The wild swan was once seen in Nipál.

The next Zoological paper, the 8th of the part, is on the wild goat and wild sheep of Nipál. And here again Mr. HODGSON is puzzled by what has puzzled all naturalists, who have studied these groups of the *Ruminantia,* from ARISTOTLE to HAMILTON SMITH;—the line of separation between the goats and the sheep. Now to a common man no doubt the matter appears easy enough: he knows a goat from a sheep and *vice versâ* any day;—but the line of separation, in spite of all this, is so narrow that the ancients considered the latter a hybrid

* On the migration of the Natatores and Grallatores, as observed at Kathmandu, page 122.

production of the former; and even at this day stories of a mixed prolific breed being common in Russia and America are rather disbelieved to be true than proved to be false, though reason and analogy alike condemn a theory so little supported by what we see, and so contrary to the common received opinions of modern science. Indeed, were it proved that such a breed is in existence, the fact would go much farther than to overthrow a mere generic distinction. It would shew that the established notion of specific differences depending upon the test of an unprolific offspring, is incorrect; and, that, instead of there being *two genera* of goats and sheep, there is in fact but *one species* of the whole. Mr. Hodgson of course leaves the matter where he found it.

Some uncertainty prevails as to the goat Mr. Hodgson describes being identical or not with one noticed by M. Duvaucel. The notice appears to have been sent to Paris, and it is appended by the Secretary to the Society to the present article, taken however from the original manuscript. M. Duvaucel's specimen, also, was a young one, and as he has not given it a name, nor yet appended the native one, it is impossible to ascertain whether or not his and Mr. Hodgson's *Capra Jháral* are the same. At all events Mr. Hodgson does not seem to have known of M. Duvaucel's paper, and the credit of first bringing this animal to notice properly belongs to him*.

Of the sheep, the *Ovis Nayaur*, Mr. Hodgson has seen only the female in the adult state, and the young of the male, and he is consequently uncertain whether it is a new species. But in a note appended to the 9th article the author says :—

"From much conversation that I had with the Bhotea who brought me the skin of the young male *Nayaur*, I now incline to believe that I was mistaken in supposing there are two species of wild sheep in these regions. The *Bharal* of one dialect is probably the *Nayaur* of another, and the Himálayan wild sheep most likely only a variety of that widely-diffused species *Ovis Argali ;* though I must confess I cannot reconcile Linnæus or Shaw's descriptions of the horns of the *Nayaur*."

The *Rátwa* deer of Mr. Hodgson, perhaps the *Cervus Muntjak* of Pennant, forms the subject of the 9th article. There is little doubt of this animal being really the *Cervus Muntjak*, the *Kijang*, or at least a variety of that species. Though Mr. Hodgson attaching more importance to colour than it deserves, thinks, that as

* Mr. Hodgson, in a private note, explains that, "M. Duvaucel's description refers to the *Ghorál*, which all our English zoologists class with the antelopes, because it has suborbital sinuses and cylindrical horns. The latter obvious character should have prevented its being confounded with the *Jháral*, which has angular horns."—Ed.

"In one of Buffon's Supplements it seems the *Cervus Muntjak* is described as of a greyish brown colour: if this be just, *Cervus Muntjak* will constitute probably a distinct species from *Râtwa;* and I cannot help thinking that, in such case, the two ought to be sectionally at least separated from *Cervus.*"

The meaning of its being sectionally separated is not very obvious. If he means, as is probable, that the *Muntjak* and its kind are generically different from the genus *Cervus,* he is quite correct, and he will find on reference to Cuvier that this separation has been already made. The new genus contains five species, natives of Java, the Phillipines, Malacca, Nepál, and several other countries.

But, to return to the author, it is certain that differences of shades of colour can hardly be a sufficient warrant for instituting a new species, though perhaps it may, by taking some latitude, a variety; colour in the whole *ruminantiæ* being liable to variation by many contingent circumstances, such as climate, season, age, sex, &c. If, therefore, there is nothing to warrant the measure of separating Mr. Hodgson's *Muntjak,* from that of Pennant, but the circumstance of the one being fulvous and the other greyish brown, the specific separation cannot be allowed.

But the *Cervus Muntjak,* sent from Sumatra, is in every instance of a *fulvous,* or *reddish brown,* the colour it would appear, of Mr. Hodgson's specimens. The individual described in Buffon's supplement was probably aged, if so the difference may readily be accounted for by the knowledge of the fact, that as old age comes on, the fulvous is gradually obliterated by the grey. The thickening of the pedestals of the horns at the top in the "form a rose," and the meaning of which Mr. Hodgson "cannot divine," is also merely a sign of age.

Thus there is little doubt of the identity of the *Muntjak* of Pennant, Buffon, Shaw, and Hodgson: and there is reason to believe, this species extends in a continued range, from the eastern Islands to Nipál, through the whole Indian continent. Two horns attached to the frontal bone are now in Calcutta, which correspond in every respect with the description of Mr. Hodgson and Sir T. S. Raffles, and which were found at *Jellasur,* in the district of *Midnapúr,* province of *Orissa;* and several fawns were brought into *Midnapúr* in the year 1831. They all died young, before the horns were developed; yet their general appearance and the form of the cranium left no doubt of their belonging to this genus.

Mr. Hodgson, however, if he has failed to establish a new species of *Stylocerus* (as the genus or subgenus is now called), has cleared up one point, that relating to the two antlers or projections on the horns, being an accident, or *lusus naturæ*, of rare instead of, as was at one time supposed, constant occurrence. A doubt has been thrown upon Pennant from this circumstance, which he does not deserve, and which our author will be glad to have satisfactorily overthrown.

Article XI. is an admirable description of the most splendid specimen of all the known species of horn bill, the *Buceros Homrai* of Hodgson. To this description nothing can be added, comprising as it does every minute point, in age, sex, and variety. Four, perhaps five, species of Buceros may now be considered as belonging to continental India, and Mr. Hodgson seems to have established the fact of their all being strictly frugivorous; and not partially carnivorous, as was erroneously supposed, from analogy with the Toucan. Indeed there is good reason to believe that this latter bird has been libelled; the cannibal propensities it has occasionally exhibited having been developed only in a state of confinement.

An anatomical notice is affixed to the description by Mr. Bramley, a gentleman whose numerous professional avocations are to be regretted as preventing him from devoting zoological talent of no ordinary standard entirely to scientific pursuits. The peculiarity in structure of the cranium mentioned by Mr. Bramley is the want of motion between it and the bill. He might also have noticed another; in the internal cavity of the bill being almost filled with osseous reticulations, instead of, for the greater part, occupied with membranous cells, as is the case in most other species of this genus. Mr. Bramley also notices the lax union of the dorsal vertebræ, and in doing so, touches upon the doctrine of compensation.

Of this doctrine it may be well to say a few words, especially as it seems to be daily gaining ground among certain speculative, but scientific men, of whom M. M. Chabrier and Audouin among the French, and MacLeay and Vigors among the English, are at present the acknowledged heads. Their great object is generalization, and the natural fondness of mankind for conjecture, their means. Their doctrine may be stated in a few words.

All animals have a determinate number of parts, differing only in the degree of development; the development of one organ exerting an inverse influence upon another.

So much for the ingenious and convenient doctrine of compensation. But to return to Mr. Bramley, who in speaking of the bill of the *Buceros Homrai* remarks:—

"The casket (which is of large dimensions) has also its horny covering, though somewhat different in structure, that of the former being laminated and bearing a close resemblance to proper horn, while that of the latter is much thinner, of a fibrous consistence, and nail-like in structure. The edges of the bills, of both mandibles, for about two-thirds of their length from the point, are horny, but the surface is so irregular and jagged that their appearance leaves no doubt that much of the natural structure has been broken off, by the use which the bird makes of its bill. In consequence of this when the jaws are close, there is a considerable vacancy between the cutting edges throughout the whole central portion of the bill. In some specimens in Mr. Hodgson's collection the fractures have taken place at such regular intervals, as to give to those parts the appearance of natural indentations.

" To entertain this supposition, however, would be erroneons, as there is evident reason to believe that in a bill which is perfect, the horn by which it is covered does not extend to its edges, but terminates just before it arrives at these, in a substance not very unlike solid bone.

" The chief difference from the latter is, that it is exceedingly brittle in its nature, though it is by no means deficient in compactness.

" That this substance borders the edges of both mandibles in their natural state, is confirmed by numerous portions which are here and there left in all the specimens I have examined. There is, also, a distinct line along the bills denoting the termination of the horn, into this hard structure, which in some individuals is of a red colour and in others a black."

Now this horny covering of the bill does not appear different from that of the casque, (or casket, as Dr. Bramley terms it,) in any essential particular, the structure in both being of a laminated rather than of a fibrous nature, and the hard callous edging of the bill is common to all the genus. In the *Homrai* it is more manifest perhaps than in some other species, but it is still more developed in the Rhinoceros Hornbill. It resembles the enamel-like shelly substance, observable at the hinge in many genera of bivalve *Mollusca*, rather than bone, and appears to be a continuation and hardened folding of the internal lining of the bill, with which it comes off, or separates, on long maceration in water. On a careful examination of a bill in this state, it will be found to be not confined to the edges of the bill, but also to be met with, in a greater or less degree, at the gape, and along the central ridges inside the mouth, both above and below.

The last zoological article in the volume is also by Mr. Hodgson, and entitled " A description of the wild dog of the Himálaya." The specific character and name are as follows :—

" Canis Primævus (mihi) the *Buansu* of the Nipálese. *Habitat*, the whole of the sub-Himalayan ranges from the Sutlej on the west to the Brahmaputra on the east.

" Specific Character. *Wild dog, with six molars only in the lower jaw, double coat, having soled feet, large erect ears, and very bushy straight tail, of medial length, deep rusty colour above, yellowish below.*"

Mr. Hodgson's object in this paper is to bring to scientific notice a new variety of dog, and to prove that variety to be, as he terms it, the *Canis primævus*. Some of his characters, it will be seen in the above quotation, are generic instead of specific. And the circumstances of there being six molars in the lower jaw, and of the peculiarities of the urine and eyes, and in short the whole differences from the common dog pointed out by Mr. Hodgson, surely so far from proving that the *Buánsu* is the *Canis primævus*, the type of the canine race, go very much in favour of the theory which may be formed by "the querulous objector," who rejecting Mr. Hodgson's speculations may bei nclined "to substitute his own; creating, if he pleases, a new subdivision of the *Digitigrades*, characterised by one tubercular tooth behind the great carnivorous tooth of the lower jaw."

But to enter fully into this subject would be to exceed the limits that can be allowed to this paper; and the more unnecessary, that after all it would still remain as uncertain as at present. But whatever may be the result of Mr. Hodgson's speculations, he has certainly given in the *Buánsu* a new animal to zoology.

Something should be said upon the subject of the plates and the nomenclature. Of the former it may be remarked, that they are considerably better than the zoological ones of the last part (indeed they could not be worse, it may fairly be presumed), though they are much inferior to others in the present part. They are evidently fac-similes of the drawings made on the spot chiefly by native artists, and it would be hazardous to deviate from these even for the sake of pictorial improvement. It is matter of congratulation that Mr. Hodgson has not followed the system of nomenclature, to which it is to be feared too many men of real genius have lent their names, that of calling a production of nature after the surname of an individual. It is a practice which must tend to the confusion of science; and which becomes ridiculous by the ill assorted union of a barbarous cognomen with a classical termination. One great reform of Linnæus was the substitution of a trivial name for a description, or *titulus*; but it was intended that that name should be descriptive in itself, so that the mind might be guided by the ear. True it is that in some instances even Linnæus forgot his own rules; but the errors of great men should be a beacon to their less talented fellows, rather than an example or an excuse. A compliment of this kind may display an amiable, a grateful, or an admiring disposition, when paid to our friends, or to public benefactors; but, this is not a subject in which they should be exhibited, for science is surely diverted from its proper channels when made to administer merely to private friendship, or to public applause.

Mr. HODGSON's plan, however, is not without objections, though infinitely superior to that deprecated above. Native names are often applied to a large class of sometimes very different animals, and vary in every district: and a name derived from the habitat is objectionable where that habitat extends through a wide range. The *Parra Chinensis*, or *Sinensis*, for it has been called by both names indiscriminately, has been found at Tamlúk; and the *Buceros Gingianus* is a native of Midnapúr.

By the above notice it will be seen that the zoological papers in this part are most creditable to Mr. HODGSON in every point of view; exhibiting as they do, his knowledge, research, and industry, in the most favourable light: and it is to be hoped that his example will be followed by the many men of talent which India can boast of, and who have time at their disposal. Among those who have already distinguished themselves in this way, may be mentioned Messrs. HODGSON, BENSON, GRANT, HUTTON*, and several anonymous contributors of articles in the "GLEANINGS IN SCIENCE," and "JOURNAL OF THE ASIATIC SOCIETY." We may fairly anticipate that their exertions will be redoubled by the example set before them by Mr. HODGSON; nay, we may surely in these times, and under a government, the head of which is so justly celebrated for the anxiety he has ever evinced to promote the cause of science, indulge a hope that officers, duly qualified for the purpose of investigating the productions of nature, will be sent upon missions, likely to afford facilities for the purpose, into remote or little frequented countries. Our expeditions, hitherto, have not been remarkable for the scientific talent they have displayed, though the countries of Java, Birma, Tibet, Siam, and Chira Punjí, afford the most valuable fossil remains of a former, and the most curious specimens of the living world. An amusing instance of the English-Indian method of pursuing scientific inquiries, is to be met with in the expedition sent by Major BURNEY to collect fossils on the site of Dr. CRAWFURD's collections; in which the exertions of that gentleman, remarkable as he is for his zeal in the cause, were frustrated by the fact of his having nobody but an Apothecary at his disposal, who was so little conversant with the subject, that though "the ground was every where strewed with fragments of petrified bones and trees, he unfortunately fell in with nothing worthy of notice." "He seems," says the Editor, "to have looked for skeletons in a more perfect state, and to have imagined that such had been collected by Dr. CRAWFURD, which is far

* To this gentleman the author of the present notice owes his thanks for some specimens of a species of *Valvata* and eggs of *Ampullaria;* and his apologies for not having noticed them before.

from being the case." It is really deplorable the manner in which natural history has been neglected in India : and justly has it been remarked that we know more of the animals of Africa than of Bengal, a country that has been so long in our possession ! France created her magnificent work on Egypt and its productions during a warlike occupancy of a few months: England after a peaceable possession of India of many times the number of years, has not, under the patronage of her Government, done enough to fill a single volume. J. T. P.

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## V.—*Note on the extraordinary Fall of the Barometer during the Gale of the 21st May last.—By* Jas. Prinsep, *Sec. &c.*

In the meteorological register for May I noticed the great fall in the Barometer which took place previous to and during the severe gale that did so much damage at the mouth of the river *Hooghly :* I have since been favored with an extract from the register of the barometer kept on board the H. C. Ship Duke of York, one of the numerous vessels wrecked or stranded along the *Hijelee* coast. This ship lay apparently in the line of greatest force of the gale, and the depression experienced in the barometer, confirmed as it is by the indications of a sympiesometer also on board, give us a terrible proof of the intensity of the storm : the fall in Calcutta was three-quarters of an inch ; at Saugor it appears by the following note, for the authenticity of which I can vouch, to have been upwards of *two inches !*

" My dear Sir,

" It is but now that I am able to forward you the particulars of the fall of the mercury during the late gale. They are as follow :—

| | | | inch. | Ther. |
|---|---|---|---|---|
| Tuesday, 21st May, 1833, | 8 A. M. | The Barometer stood at,....... | 29.09 | 80 |
| | 9 ,, | ..................... | 28.67 | 80½ |
| | 10 ,, | ..................... | 28.00 | 80 |
| | 11 ,, | no mercury in sight in the tube*, | 26.30 | 80 |
| | 11.30 ,, | mercury re-appeared,............ | 26.50 | 80 |
| | Noon, | ..................... | 27.00 | 79½ |
| | 4 P. M. | ..................... | 27.50 | 79 |
| | 8 ,, | ..................... | 28.00 | 80 |
| | Midnight, | ..................... | 28.60 | 80½ |
| Wednesday, 22nd.... | 4 A. M. | ..................... | 28.20 | 81 |
| | 8 ,, | ..................... | 28.30 | 82 |
| | Noon, | ..................... | 28.60 | 84 |

" The times of the changes are copied from those set down almost immediately after the gale, of course from recollection. Some of the lower altitudes of the mercury, also, may be more or less incorrect, having been below the range of the index.

" The oil in the sympiesometer retired completely into the bulb when the mercury in the barometer disappeared, and rose again a little before it. The mer-

* We presume this must have been below 26.50 inches.—Ed.

cury in the barometer did not, after Tuesday night, or rather Wednesday morning, act as it should have done, which was found to be owing to some water having got down upon the leather bag and loosened it from the wood, and so having permitted the escape of the mercury." W. T. D.

The severity of this hurricane fell on *Kedgeree* and *Saugor*. It was not felt at Balasore. Should simultaneous observations have been made at *Midnapúr*, or elsewhere within its influence, they will prove useful in tracing its course.

I take this opportunity of recording the observations made during the storm of the 7th October, 1832, which were delayed at the time in expectation of receiving further information such as should enable me to *map* the progress of the storm, but in vain, as I was only favored with coincident observations at *Ghazipúr*, which place may be esteemed quite out of the influence of the phenomenon, although a slight fall of 0.110 inch is perceptible in the register. The first column in the table below is derived from the log of the ship London, Captain Wimble, which, it may be remembered, of all the ships then running up the Bay, experienced the effects of the gale in the severest manner, being dismasted and nearly destroyed. This gale however fell far short of the recent hurricane.

*Range of the Barometer during the Gale of the 7th October*, 1832.

| Date. | Hour. | On board the London, Lat. 18° 26′ to 20°23′ Long. 86° 30′ to 90° E. | | At Calcutta, reduced to 32°. Farh. | | At Ghazipúr. |
|---|---|---|---|---|---|---|
| | | *inches.* | | *inches.* | | *inches.* |
| 6th | 8 A. M. | 29.70 | cloudy weather, | 29.76 | rainy, N.E. | 29.82 |
| | Midnight, | 29.50 | squalls and rain, | 29.69 | gale E. | |
| 7th | 8 A. M. | 29,40 | ditto, N. E. | 29.55 | ditto, rain, E. | 29.75 |
| | 10 A. M. | —— | strong gales, E.N.E. | 29.52 | increasing, E. | |
| | Noon, | 28.90 | increasing, | 29.41 | shifted to S.W. | |
| | 4 P. M. | 28.80 | fresh gales E. by N. | 29.20 | maximum force, | 29.65 |
| | 6 P. M. | 28.50 | a hurricane, | 29.32 | moderating, S.W. | |
| | 8 P. M. | 27.80 | tremendous hurricane, | —— | ditto, S. W. | |
| | 9 P. M. | 28.10 | wind shifted to S. W. and blew with | | | |
| | 10 P. M. | 28.20 | increased violence, | 29.54 | ditto, S. W. | 29.71 |
| | 12 P. M. | 29.00 | more moderate, | | | |
| 8th | 6 A. M. | 29.30 | moderating, S.W. | 29.66 | strong wind, S.W. | |
| | Noon, | 29.50 | strong gales, high sea, | 29.73 | abated, N. W. | |
| 9th | 6 A. M. | 29.80 | strong breezes, S.W. | 29.75 | cloudy, S. E. | 29 71 |

At Bankura (by the Met. Register published in the last No.) the fall of the barometer was 0.480 inches.

## VI.—*Climate of Singapúr.*

The following abstract tables of the Thermometrical and Barometrical range for six years at *Singapúr* were drawn up by Captain C. E. Davis from his own daily observations, and were presented to the Asiatic Society in the year 1827. The barometer is not corrected to the freezing point, neither are the hours selected capable of shewing the diurnal oscillations of the pressure; but in all other respects the tables are very regular, and form a valuable addition to our meteorological information.

| 1820. | Barometer. Average of the Month. 6 A. M. | Noon. | 6 P. M. | Barometer. Greatest Range. 6 A. M. | Noon. | 6 P. M. | Barometer. Least Range. 6 A. M. | Noon. | 6 P. M. | Thermometer. Average of the Month. 6 A. M. | Noon. | 6 P. M. | Thermometer. Greatest Range. 6 A. M. | Noon. | 6 P. M. | Thermometer. Least Range. 6 A. M. | Noon. | 6 P. M. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, | 29.88 | 29.92 | 29.88 | 29.90 | 29.94 | 29.90 | 29.86 | 29.90 | 29.86 | 74.1 | 81.2 | 77.3 | 76. | 85. | 83. | 72. | 73. | 72. |
| February, | 29.87 | 29.90 | 29.87 | 29.92 | 29.95 | 29.95 | 29.82 | 29.85 | 29.80 | 74.4 | 81.7 | 78.8 | 76. | 86. | 84. | 72. | 76. | 74. |
| March, | 29.90 | 29.89 | 29.87 | 29 99 | 299.5 | 29.95 | 29.82 | 29.84 | 29.80 | 74.8 | 82.9 | 80.6 | 76. | 86. | 83. | 72. | 75. | 75. |
| April, | 29.89 | 29.98 | 29.87 | 29.96 | 30.01 | 29.93 | 29.82 | 29.84 | 29.81 | 75.6 | 84.6 | 82.2 | 77. | 86. | 85. | 74. | 80. | 78. |
| May, | 29.88 | 29.89 | 29.84 | 29.98 | 29.98 | 29.93 | 29.78 | 29.78 | 29.75 | 76.6 | 85.4 | 84. | 82. | 88. | 87. | 73. | 80. | 78. |
| June, | 29.90 | 29.92 | 29.86 | 29.97 | 29.98 | 29.94 | 29.83 | 29.86 | 29.83 | 76.2 | 86. | 84. | 78. | 87. | 85. | 73. | 74. | 75. |
| July, | 29.90 | 29.91 | 29.89 | 29.97 | 29.98 | 29.95 | 29.83 | 29.85 | 29.82 | 75.5 | 82.1 | 81.2 | 78. | 86. | 85. | 73. | 76. | 76. |
| August, | 29.90 | 29.93 | 29.90 | 29.96 | 29.99 | 29.98 | 29.85 | 29.86 | 29.83 | 76.6 | 82.2 | 81.8 | 82. | 88. | 85. | 73 | 74. | 76. |
| September, | 29.93 | 29.95 | 29.91 | 29.98 | 30.01 | 29.95 | 29.88 | 29 90 | 29.88 | 76.1 | 82.5 | 81.4 | 80. | 87. | 85. | 74. | 77. | 76. |
| October, | 29.92 | 29.94 | 29.89 | 29.97 | 30.01 | 29.94 | 29.87 | 29.87 | 29.85 | 75.8 | 83. | 81.9 | 79. | 87. | 88. | 74. | 78. | 75. |
| November, | 29.87 | 29.91 | 29.86 | 29.94 | 29.98 | 29.94 | 29.81 | 29.85 | 29.78 | 75. | 82.8 | 80.1 | 77. | 86. | 86. | 72. | 76. | 75. |
| December, | 29.88 | 29.94 | 29.90 | 29.94 | 29.99 | 29.98 | 29.83 | 29.89 | 29.83 | 74.9 | 80.2 | 78.2 | 77. | 85. | 83. | 72. | 75. | 74. |
| Annual average, | 29.90 | 29.92 | 29.88 | 29.95 | 29.98 | 29.98 | 29.83 | 29.85 | 29.82 | 75.7 | 82.8 | 80.9 | 87.1 | 86.4 | 84.1 | 73. | 75.3 | 75.3 |
| January, 1821, | 29.98 | 29.96 | 29.91 | 30.02 | 30.05 | 30.00 | 29.83 | 29.86 | 29.83 | 73.5 | 80. | 77.9 | 75. | 84.5 | 82. | 70.5 | 73.5 | 72.5 |
| February, | 29.98 | 29.99 | 29.94 | 30.04 | 30.06 | 30.05 | 29.91 | 29.91 | 29.82 | 74.5 | 83.5 | 80.8 | 76. | 85. | 84. | 73. | 81. | 77. |
| March, | 29.93 | 29.97 | 29.91 | 29.99 | 30.01 | 29.96 | 29.83 | 29.92 | 29.84 | 75. | 83.9 | 81.8 | 78. | 87. | 84. | 72. | 79. | 75. |
| April, | 29.98 | 29.96 | 29.92 | 29.96 | 30.00 | 29.92 | 29.87 | 29.90 | 29.83 | 77. | 82.1 | 80.3 | 78. | 87. | 85. | 74. | 77. | 80. |
| May, | 29.98 | 29.92 | 29.88 | 29.94 | 29.96 | 29.94 | 29.80 | 29.86 | 29.80 | 77.8 | 85.6 | 83.2 | 83. | 89. | 86 | 75. | 77. | 79. |
| June, | 29.88 | 29.98 | 29.94 | 30.00 | 30.03 | 29.99 | 29.87 | 29.91 | 29.87 | 77.4 | 84.8 | 83.6 | 82. | 88. | 86. | 74. | 79. | 80. |
| July, | 29.95 | 29.91 | 29.85 | 29.96 | 29.99 | 29.94 | 29.86 | 29.86 | 29.82 | 78.6 | 83.9 | 83.3 | 82. | 88. | 88. | 75. | 77. | 78. |
| August, | 29.91 | 29.94 | 29.90 | 29.98 | 30.01 | 29.97 | 29.84 | 29.84 | 29 84 | 76.2 | 84 2 | 83.6 | 82. | 88. | 85. | 75. | 78. | 78. |
| September, | 29.93 | 29.95 | 29.89 | 29.98 | 30.03 | 29.97 | 29.84 | 29.87 | 29.84 | 74.5 | 83.5 | 82 5 | 82. | 88. | 87. | 75. | 78. | 79. |
| October, | 29.91 | 29.97 | 29.91 | 30.00 | 30.03 | 29.96 | 29.88 | 29.88 | 29.85 | 77.2 | 83.6 | 82.7 | 82. | 88. | 86. | 75. | 77. | 79. |
| November, | 29.91 | 29.95 | 29.96 | 29.96 | 30.00 | 29.98 | 29.85 | 29.90 | 29.84 | 76.6 | 83.9 | 82. | 79. | 86. | 85. | 74. | 78. | 77. |
| December, | 29.92 | 29 94 | 29.86 | 29.98 | 29.99 | 29.94 | 29.83 | 29.88 | 29.83 | 75.6 | 82.7 | 80.5 | 78. | 86. | 85. | 74. | 76. | 76. |
| Annual average, | 29,93 | 29.95 | 29.91 | 29.98 | 30.01 | 29.97 | 29.85 | 29.88 | 29.83 | 76.4 | 83.5 | 81.9 | 79. | 87. | 85. | 73.8 | 77.6 | 77.6 |

| 1822. | Barometer. | | | | | | | | | Thermometer. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average of the Month. | | | Greatest Range. | | | Least Range. | | | Average of the Month. | | | Greatest Range. | | | Least Range. | | |
| | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. |
| January, ........ | 29.94 | 29.97 | 29.92 | 29.99 | 30.00 | 29.99 | 29.88 | 29.88 | 29.82 | 75.5 | 82.9 | 81. | 77. | 86.5 | 86. | 73. | 75. | 74. |
| February, ....... | 29.92 | 29.93 | 29.91 | 29.98 | 30.04 | 29.98 | 29.85 | 29.88 | 29.82 | 75.7 | 84.4 | 82. | 77. | 86.5 | 86. | 73. | 78. | 78. |
| March, ......... | 29.96 | 29.97 | 29.92 | 30.02 | 30.05 | 29.99 | 29.90 | 29.91 | 29.87 | 76. | 84.4 | 82. | 77. | 89. | 85. | 74. | 77. | 78. |
| April, .......... | 29.93 | 29.96 | 29.90 | 30.00 | 30.04 | 29.96 | 29.88 | 29,91 | 29.84 | 76.4 | 85. | 82.6 | 78. | 87. | 86.5 | 73. | 81. | 80. |
| May, ........... | 29.89 | 29.91 | 29.85 | 29.99 | 30.03 | 29.94 | 29 80 | 29.77 | 29.78 | 75.5 | 85.3 | 83.6 | 84. | 88.5 | 87. | 76. | 80. | 79.5 |
| June, .......... | 29.90 | 29.92 | 29.89 | 29.97 | 29.99 | 29.95 | 29.80 | 29.77 | 29 78 | 78.4 | 84.6 | 83.3 | 83. | 88. | 87. | 74. | 77. | 74.5 |
| July, ........... | 29.91 | 29.92 | 29.88 | 29.97 | 29.99 | 29.96 | 29.86 | 29.88 | 29.81 | 77.8 | 86.6 | 81.2 | 83. | 89. | 87. | 75. | 76. | 76. |
| August, ........ | 29.91 | 29.93 | 29.88 | 29.99 | 29.99 | 29.94 | 29.85 | 29.88 | 29.82 | 76.6 | 82.2 | 85.4 | 81. | 87. | 86. | 72. | 77. | 79. |
| September, ...... | 29.90 | 29 92 | 22.87 | 29.98 | 29.99 | 29.95 | 29.84 | 29.87 | 29.81 | 76 9 | 84.4 | 84. | 80. | 88. | 86. | 75. | 75. | 79. |
| October, ........ | 29 90 | 29.93 | 29.91 | 29.95 | 29.98 | 29 97 | 29.84 | 29.85 | 29.83 | 77. | 84.9 | 82.9 | 80. | 89. | 86. | 73. | 80. | 79. |
| November, ...... | 29.91 | 29.93 | 29.89 | 29.94 | 29.97 | 29.94 | 29.87 | 29.88 | 29.84 | 76.2 | 83.5 | 82.5 | 78. | 88. | 85. | 74. | 78. | 77. |
| December, ...... | 29.89 | 29.91 | 29.86 | 29 98 | 29.99 | 29.92 | 29.83 | 29.85 | 29.80 | 75 1 | 80.6 | 79.3 | 78. | 85. | 84. | 73. | 73. | 74. |
| Annual average, . . | 29.91 | 29.93 | 29.89 | 29.98 | 30.00 | 29.96 | 29 85 | 29.86 | 29.82 | 76.4 | 84.0 | 82.5 | 79.1 | 87.6 | 85.9 | 73.8 | 77.2 | 77.3 |
| January, 1823, .... | 29.95 | 29.97 | 29.92 | 30.06 | 30.06 | 29.99 | 29.89 | 29.84 | 29.86 | 74.2 | 81. | 79.2 | 76. | 85. | 83. | 72. | 76. | 74. |
| February, ....... | 29.95 | 29.97 | 29.93 | 30.02 | 30.07 | 29.99 | 29.88 | 29.86 | 29.83 | 74.2 | 82.3 | 80.1 | 76. | 86. | 84. | 72. | 74. | 76. |
| March, ......... | 29.88 | 29.95 | 29.89 | 29.99 | 30.00 | 29.95 | 29.87 | 29.88 | 29.83 | 73.3 | 84.6 | 81.4 | 78. | 87. | 84. | 74. | 79. | 78. |
| April, .......... | 29.91 | 29 91 | 29.85 | 29.95 | 29.96 | 29.90 | 29.85 | 29.87 | 29.84 | 76.1 | 84.8 | 82.3 | 78. | 87. | 85. | 72. | 79. | 78. |
| May, ........... | 29.87 | 29.90 | 29.86 | 29.91 | 29,95 | 29.91 | 29.84 | 29 86 | 29.81 | 77.3 | 83.8 | 82.5 | 79. | 87. | 86. | 75. | 81. | 78. |
| June, .......... | 29.88 | 29.90 | 29.87 | 29·94 | 29.97 | 29.91 | 29.81 | 29.83 | 29.81 | 77.4 | 84. | 83:1 | 82. | 87. | 86. | 75. | 78. | 81. |
| July, ........... | 29.89 | 29.90 | 29.84 | 29.92 | 29.95 | 29.91 | 29.83 | 29.83 | 29.80 | 76.7 | 84.8 | 83.9 | 81. | 88. | 86. | 74. | 79. | 81. |
| August, ........ | 29.90 | 29.91 | 29.88 | 29.94 | 29.96 | 29.91 | 29.85 | 29.85 | 29.83 | 77.7 | 83.5 | 82.7 | 81. | 87. | 85. | 75. | 78. | 77. |
| September, ...... | 29.91 | 29.94 | 29.88 | 29.96 | 29.97 | 29.92 | 29.87 | 29.89 | 29.84 | 77·3 | 84.9 | 83.8 | 81. | 88. | 86. | 75. | 76. | 76. |
| October, ........ | 29.92 | 29.93 | 29.90 | 29.99 | 29.99 | 29.93 | 29.85 | 29.85 | 29.82 | 76.5 | 83.6 | 82.8 | 82. | 86. | 86. | 74. | 78. | 79. |
| November, ...... | 29.91 | 29.93 | 29.90 | 29.96 | 29.98 | 29.98 | 29.85 | 29.88 | 29.85 | 75.7 | 82.3 | 80.6 | 78. | 88. | 88. | 74. | 77. | 76. |
| December, ...... | 29.95 | 29.96 | 29.92 | 29 99 | 30.03 | 29.98 | 29.89 | 29.90 | 29.85 | 75.5 | 83.6 | 81.3 | 76. | 85. | 86. | 73. | 81. | 73. |
| Annual average, . | 29.91 | 29.93 | 29.88 | 29.97 | 29.99 | 29.94 | 29.87 | 29.87 | 29.83 | 75.9 | 83.7 | 82.1 | 79. | 86.9 | 85.4 | 73.7 | 78. | 77.6 |

| 1824. | Barometer. | | | | | | | | | Thermometer. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average of the Month. | | | Greatest Range. | | | Least Range. | | | Average of the Month. | | | Greatest Range. | | | Least Range. | | |
| | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. | 6 A. M. | Noon. | 6 P. M. |
| January, ...... | 29.99 | 30.00 | 29.97 | 30.09 | 30.10 | 30.09 | 29.87 | 29.88 | 29.85 | 75.4 | 83.3 | 80.3 | 77. | 87. | 85. | 72. | 77. | 77. |
| February, .... | 29.95 | 29.96 | 29.94 | 30.03 | 30.00 | 29.97 | 29.87 | 29.90 | 29.90 | 76.3 | 83 9 | 81.6 | 78. | 88. | 84. | 74. | 80. | 78. |
| March, ........ | 29.94 | 29.96 | 29.90 | 30.08 | 30.09 | 30.04 | 29.88 | 29.91 | 29.86 | 77.6 | 84.2 | 80.3 | 80. | 86. | 85. | 74. | 79. | 81. |
| April, ........ | 29.90 | 29.94 | 29.88 | 29.97 | 30.02 | 29.95 | 29.85 | 29.86 | 29.82 | 78.9 | 84.5 | 83.2 | 81. | 88. | 89. | 76. | 78. | 78. |
| May, ........ | 29.88 | 29.92 | 29.90 | 29.94 | 29.97 | 29.92 | 29.83 | 29.85 | 29.81 | 77.7 | 83.1 | 82.8 | 83. | 86. | 85. | 74. | 76. | 81. |
| June, ........ | 29.89 | 29.90 | 29.84 | 29.93 | 29.96 | 29.95 | 29.88 | 29.82 | 29.80 | 79.1 | 84.5 | 83.4 | 82. | 86. | 86. | 74. | 80. | 78. |
| July, ........ | 29.92 | 29.93 | 29.98 | 29.98 | 30.00 | 29.95 | 29.80 | 29.88 | 29.86 | 80. | 84.9 | 86.4 | 83. | 87. | 86. | 76. | 80. | 80. |
| August, ...... | 29.84 | 29.96 | 29.90 | 29.96 | 30.00 | 29.98 | 29.87 | 29.87 | 29.87 | 79.4 | 84.5 | 83.7 | 82. | 88. | 86. | 75. | 77. | 77. |
| September, .... | 29.92 | 29.95 | 29.90 | 29.98 | 29.99 | 29.95 | 29.87 | 29.90 | 29.86 | 77.3 | 84.3 | 83.8 | 82. | 88. | 87. | 74. | 76. | 79. |
| October, ..... | 29.91 | 29.93 | 29.89 | 29.97 | 29.99 | 29.94 | 29.87 | 29.87 | 29.85 | 76.6 | 84.3 | 83.1 | 78. | 87. | 86. | 74. | 79. | 78. |
| November, .... | 29.91 | 29.93 | 29.89 | 29.95 | 30.00 | 29.95 | 29.83 | 29.85 | 29.81 | 76.4 | 82.5 | 81.6 | 82. | 86. | 85. | 73. | 79. | 76. |
| December, .... | 29.97 | 29.96 | 29.92 | 30.00 | 30.03 | 29.99 | 29.90 | 29.92 | 29.89 | 75.3 | 80.2 | 79.8 | 78. | 84. | 83. | 73. | 75. | 77. |
| Annual average, | 29.91 | 29.94 | 29.90 | 29.99 | 30.06 | 29.97 | 29.85 | 29.87 | 29.84 | 77.7 | 84. | 82.7 | 80.7 | 87. | 85.8 | 74.2 | 78.2 | 78.2 |
| January, 1825, .. | 29.94 | 29.95 | 29.92 | 30.03 | 30.06 | 29.99 | 29.90 | 29.90 | 29.87 | 75.1 | 80.9 | 79.9 | 77. | 86. | 83. | 72. | 75. | 74. |
| February, .... | 29.96 | 29.99 | 29.93 | 30.02 | 30.04 | 30.00 | 29.88 | 29.91 | 29.87 | 86.2 | 85.2 | 79.8 | 79. | 87. | 85. | 74. | 82. | 78. |
| March, ........ | 29.91 | 29.93 | 29.89 | 29.97 | 29·99 | 29,97 | 29.83 | 29.85 | 29.83 | 76.5 | 84.6 | 83.6 | 80. | 88. | 86. | 73. | 76. | 79. |
| April, ........ | 29.91 | 29.94 | 29.88 | 29.99 | 29.99 | 29.95 | 29.85 | 29.87 | 29.82 | 77.2 | 84.6 | 83.7 | 81. | 87. | 87. | 73. | 80. | 79. |
| May, ........ | 29.88 | 29.91 | 29.87 | 29.94 | 29.99 | 29.91 | 29.83 | 29.84 | 29.82 | 77.6 | 84.7 | 83.7 | 81. | 87. | 86. | 75. | 78. | 80. |
| June, ........ | 29.89 | 29.91 | 29.88 | 29.98 | 29.97 | 29.97 | 29.80 | 29.86 | 29.82 | 79.9 | 84.3 | 84.1 | 84. | 88. | 87. | 75. | 77. | 77. |
| July, ........ | 29.88 | 29.85 | 29.87 | 29.95 | 29.96 | 29.92 | 29.82 | 29.83 | 29.83 | 76.6 | 82.9 | 82.6 | 82. | 88. | 85. | 73. | 78. | 77. |
| August, ...... | 29.91 | 29.93 | 29.91 | 29.95 | 29.99 | 29.95 | 29.85 | 29.88 | 29.84 | 76.5 | 82.2 | 81.4 | 81. | 87. | 85. | 75. | 78. | 78. |
| September, .... | 29.92 | 29.98 | 29.91 | 29.99 | 30.03 | 29.98 | 29.85 | 29.87 | 29.83 | 77.6 | 83.3 | 80.6 | 82. | 87. | 85. | 74. | 76. | 77. |
| October, ...... | 29.91 | 29.93 | 29.90 | 29.96 | 29.97 | 29.95 | 29.83 | 29.88 | 29.80 | 76.8 | 83.6 | 83.5 | 79. | 88. | 86. | 75. | 76. | 79. |
| November, .... | 29.97 | 29.89 | 29.87 | 29.91 | 29.95 | 29.93 | 29.80 | 29.83 | 29.80 | 76.6 | 84.3 | 82.9 | 79. | 86. | 86. | 71. | 80. | 79. |
| December, .... | 29.88 | 29.90 | 29.88 | 29.94 | 30.00 | 29.98 | 29.82 | 29.85 | 29.82 | 75.7 | 81.7 | 80.8 | 78. | 85. | 86. | 73. | 75. | 75. |
| Annual average, | 29.90 | 29.92 | 29.89 | 29.97 | 29.99 | 29.95 | 29.84 | 29.86 | 29.83 | 76.8 | 83.6 | 82.2 | 80.2 | 87. | 85.6 | 73.6 | 77.6 | 77.6 |

## VII.—*Culminating Stars observed with the Moon at Násirabád. By Lieut.-Colonel* Thos. Oliver, &c.

| Date. | Stars. | No. of wires. | Sidereal Time of Transit. | Intervals in sidereal time. |
|---|---|---|---|---|
| | | | H. M. S. | H. M. S. |
| February 16th, 1831, | ☽'s 1st border, ...... | 5 | 0 58 52.0 | |
| | α Ceti, ............. | 5 | 2 53 26.4 | +1 54 34.4 |
| March 21st, 1831,.. | α Orionis, ....... .... | 5 | 5 46 01.8 | —0 48 31.3 |
| | ☽'s 1st border, ...... | 5 | 6 34 33.1 | |
| | α Geminorum, .. .... | 5 | 7 23 49.0 | +0 49 15.9 |
| | α Canis min...... .... | 5 | 7 30 27.6 | 0 55 54.5 |
| | β Geminorum, .. .... | 5 | 7 34 58.4 | 1 00 25.3 |
| March 22nd, .. .... | α Orionis, ......... .. | 5 | 5 46 01.8 | —1 48 34.8 |
| | α Geminorum,.. .... | 5 | 7 23 48.9 | 0 10 47.7 |
| | α Canis min....... .... | 5 | 7 30 27.6 | 0 04 09.0 |
| | ☽'s 1st border, ...... | 5 | 7 34 36.6 | |
| September 14th. .. | α Scorpii, ... ...... | 4 | 16 19 04.7 | —1 17 54.2 |
| | ☽'s 1st border,.... .. | 5 | 17 36 58.9 | |
| November 12th,.... | ☽'s 1st border, ...... | 5 | 21 15 55.0 | |
| | β Aquarii, ....... .... | 5 | 21 22 40.8 | +0 06 45.8 |
| | No. 2575, .. ........ | 5 | 21 33 52.4 | 0 17 57.4 |
| | 2586,.... .... .. | 5 | 21 37 43.7 | 0 21 48.7 |
| November 13th,.... | β Aquarii, .... ...... | 5 | 21 22 41.1 | —0 44 51.8 |
| | No. 2643, ....... .... | 5 | 22 04 25.6 | 0 03 07.3 |
| | ☽'s 1st border, ...... | 5 | 22 07 32.9 | |
| February 8th, 1832, | α Arietis,........... | 5 | 1 57 42.4 | —0 24 44.0 |
| | ☽'s 1st border, ...... | 5 | 2 22 26.4 | |
| | No. 293, ........... | 3 | 2 35 51.9 | +0 13 25.5 |
| | α Tauri, ........... | 5 | 4 26 17.6 | 2 03 51.2 |
| February 10th, .... | α Arietis, ...... .. .... | 5 | 1 57 42.2 | —2 18 21.3 |
| | No. 375, ........... | 5 | 3 18 03.7 | 0 57 59.8 |
| | 383, ........... | 5 | 3 24 29.9 | 0 51 33.6 |
| | 392, ........... | 5 | 3 30 44.8 | 0 45 18.7 |
| | ☽'s 1st border, ...... | 5 | 4 16 03.5 | |
| | No. 571, ........... | 5 | 4 19 04.4 | +0 03 00.9 |
| | α Tauri, ........... | 5 | 4 26 17.1 | 0 10 13.6 |
| March 9th, ........ | ☽'s 1st border, ...... | 5 | 4 57 29.9 | |
| | γ Orionis, .... ...... | 5 | 5 16 07.3 | +0 18 37.4 |
| March 10th, .. .. .. | α Tauri, ...... ...... | 5 | 4 26 17.3 | —1 33 05.0 |
| | δ Orionis, .... ...... | 5 | 5 23 25.3 | 0 35 57.0 |
| | ζ ....... ......... | 5 | 5 32 16.8 | 0 27 05.5 |
| | α ................ | 5 | 5 46 04.5 | 0 13 17.8 |
| | ☽'s 1st limb, ........ | 5 | 5 59 22.3 | |
| | No. 768, ........... | 5 | 6 02 04.5 | +0 02 42.2 |
| March 12th, .. .... | α Tauri, ...... ...... | 5 | 4 26 17.0 | —3 39 23.1 |
| | γ Orionis, .... ...... | 5 | 5 16 07.1 | 2 49 33.0 |
| | α ................ | 5 | 5 46 04.7 | 2 19 35.4 |
| | β Geminorum, ...... | 5 | 7 35 01.9 | 0 30 38.2 |
| | ☽'s 1st border, | 5 | 8 05 40.1 | |

| Date. | Stars. | No. of Wires. | Sidereal time of Transit. | Intervals in Sidereal time. |
|---|---|---|---|---|
| | | | H. M. S. | H. M. S. |
| April 8th, ........ | α Geminorum, ....... | 5 | 7 23 52.2 | — 0 22 28.4 |
| | α Canis min, ......... | 5 | 7 30 30.2 | 0 15 50.4 |
| | β Geminorum, ...... | 5 | 7 35 01.6 | 0 11 19.0 |
| | ☽'s 1st border, ....... | 5 | 7 46 20.6 | |
| | No. 989, ............ | 5 | 7 56 20.7 | + 0 10 00.1 |
| May 7th, .......... | ☽'s 1st border, ...... | 5 | 9 29 32.9 | |
| | No. 1197, ........... | 5 | 9 51 20.2 | + 0 21 47.3 |
| | α Leonis, ........... | 5 | 9 59 25.5 | 0 29 52.6 |
| May 9th, .......... | α Hydræ, ........... | 5 | 9 19 20.0 | — 2 01 10.5 |
| | α Leonis, ............ | 5 | 9 59 25.6 | 1 21 04.9 |
| | No. 1338, ........... | 2 | 11 15 11.0 | 0 05 19.5 |
| | ☽'s 1st border, ...... | 5 | 11 20 30.5 | |
| | No. 1369, ........... | 5 | 11 36 38.7 | + 0 16 08.2 |
| June 6th, ......... | β Leonis, ........... | 4 | 11 40 29.3 | — 0 16 49.2 |
| | ☽'s 1st border, ...... | 5 | 11 57 18.5 | |
| | α Virginis, .......... | 5 | 13 16 22.1 | + 1 19 03.6 |
| June 7th, ......... | No. 1465, ........... | 5 | 12 33 09.7 | — 0 14 53 6 |
| | ☽'s 1st border, ...... | 5 | 12 48 03.3 | |
| October 1st, ...... | ☽'s 1st border, ...... | 5 | 18 21 28.1 | |
| | β Aquarii, .......... | 5 | 21 22 44.6 | + 3 01 16.5 |
| November 1st, .... | β Aquarii, ........... | 5 | 21 22 44 1 | — 0 04 37.1 |
| | ☽'s 1st border, ...... | 5 | 21 27 21.2 | |
| | γ Capricornis, ...... | 5 | 21 30 47.7 | + 0 03 26.5 |
| | α Aquarii, ........... | 5 | 21 57 10.9 | 0 29 49.7 |
| | α Piscis aust, ........ | 5 | 22 48 23.4 | 1 21 02.9 |
| November 29th, .... | β Aquarii, ........... | 5 | 21 22 44.4 | — 0 34 00.8 |
| | ☽'s 1st border, ...... | 5 | 21 56 44.8 | |
| | α Piscis aust, ........ | 5 | 22 48 22.8 | + 0 51 38.0 |
| March 1st 1833, .... | α Tauri, ............ | 5 | 4 26 20.4 | — 2 03 57.8 |
| | γ Orionis, ........... | 5 | 5 16 10.3 | 1 14 07.9 |
| | No. 804, ............ | 5 | 6 19 03.0 | 0 11 15.2 |
| | ☽'s 1st border, ...... | 5 | 6 30 18.2 | |
| | α Geminorum, ...... | 5 | 7 23 56.6 | + 0 53 38.4 |
| March 28th, ...... | β Tauri, ........... | 5 | 5 15 43.5 | — 0 52 50.4 |
| | No. 684, ............ | 5 | 5 27 39.3 | 0 40 54.6 |
| | 775, ............ | 5 | 6 04 47.1 | 0 03 46.8 |
| | ☽'s 1st border, ...... | 5 | 6 08 33.9 | |
| | No. 820, ............ | 5 | 6 28 03.3 | + 0 19 29.4 |
| | 831, ............ | 5 | 6 33 39.1 | 0 25 05.2 |
| | 872, ............ | 5 | 6 54 12.0 | 0 45 38.1 |
| | α Geminorum, ...... | 5 | 7 23 56.1 | 1 15 22 2 |
| | β ................ | 5 | 7 35 05.2 | 1 26 31.3 |
| March 30th, ...... | α Geminorum, ...... | 5 | 7 23 56.0 | — 0 50 23.6 |
| | β ................ | 5 | 7 35 05.1 | 0 39 14.5 |
| | No. 967, ............ | 5 | 7 45 54.8 | 0 28 24.8 |
| | ☽'s 1st border, ...... | 5 | 8 14 19.6 | |
| | No. 1048, ........... | 5 | 8 30 07.0 | + 0 15 47.4 |

| Date. | Stars. | No. of Wires. | Sidereal time of Transit. | Intervals in Sidereal time. |
|---|---|---|---|---|
| | | | H. M. S. | H. M. S. |
| March 31st, .. .. .. | α Canis min. ....... .... | 5 | 7 30 33.4 | — 1 46 31.9 |
| | β Geminorum, ...... | 5 | 7 35 05.2 | 1 42 00.1 |
| | No. 1130, .... ....... | 5 | 9 09 39 6 | 0 07 25.7 |
| | ☽'s 1st border, ...... | 5 | 9 17 05.3 | |
| | α Leonis, .... .. .... | 5 | 9 59 29.1 | + 0 42 23.8 |
| | No. 1222, .... ...... | 5 | 10 07 43.2 | 0 50 37.9 |
| | No. 1232, .... ...... | 5 | 10 12 51.6 | 0 55 46.3 |
| April 27th, ........ | No. 1097, .... .. .... | 5 | | — 0 07 32.5 |
| | ☽'s 1st border,...... | 5 | * | |
| | No. 1122, .... ...... | 5 | | + 0 09 07.2 |
| | 1130, .... ...... | 5 | | 0 12 46.3 |
| April 28th, ........ | No. 1171, .... .... .... | 5 | 7 32 14.3 | — 2 24 50.7 |
| | 1175, .... ...... | 5 | 9 36 21.9 | 0 20 43.1 |
| | 1193, .. .... .... | 5 | 9 49 14.4 | 0 07 50.6 |
| | ☽'s 1st border,...... | 5 | 9 57 05.0 | |
| | α Leonis, .... .. .... | 5 | 9 59 28.8 | + 0 02 23.8 |
| | No. 1254, .... .. .... | 5 | 10 24 01.2 | 0 26 56.2 |
| | 1284, .... .. .... | 5 | 10 40 29.1 | 0 43 24.1 |
| April 29th, ........ | α Leonis,............ | 5 | 9 59 28.6 | — 0 55 40.2 |
| | No. 1254, .... ...... | 5 | 10 24 01.2 | 0 31 07.6 |
| | 1303, ...... .... | 5 | 10 52 05.6 | 0 03 03.2 |
| | ☽'s 1st border, ...... | 5 | 10 55 08.8 | |
| | No. 1328, .......... | 5 | 11 08 42.1 | + 0 13 33.3 |
| | 1334, ....... .... | 5 | 11 12 31.7 | 0 17 22.9 |
| | 1338, .... ...... | 5 | 11 15 13.2 | 0 20 04.4 |
| April 30th, ........ | α Leonis, .... .. .... | 5 | 9 59 28.8 | — 1 51 50.1 |
| | No. 1371, .... ...... | 5 | 11 37 17.3 | 0 14 01.6 |
| | β Leonis, .... ...... | 5 | 11 40 32.9 | 0 10 46.0 |
| | ☽'s 1st border, ...... | 5 | 11 51 18 9 | |
| | No. 1415,.. .... .... | 5 | 12 11 22.5 | + 0 20 03.6 |

N. B. The numbers in the column headed "Stars" refer to the Catalogue of the London Astronomical Society.

Any of your readers who may have had observations of Moon Culminating Stars corresponding with any of the above, will confer a favor on me by publishing them in your valuable Journal.

## VIII.—*Chemical Analyses.* *By* Jas. Prinsep, *Sec., &c.*

### 1. *Three specimens of soil from sugar-cane fields.*

The first was from a village called *Mothí* on the *Sarju*, ten miles north of the bank of the Ganges at Buxar. The other two were from soils on the south bank of the Ganges near the same place. Nos. 1 & 2 are represented as requiring irrigation, and No. 3, as sufficiently retentive of moisture to render it unnecessary. There is a substratum of *kankar*

* This evening I had no observations of well known Stars to determine the error of the Chronometer and Instrument : but the Intervals may, I think, be depended on.

throughout the whole of that part of the country, and to some mixture of this earth with the surface soil the fertility of the latter is ascribed: the cane produced is of small size, but it yields a pretty rich juice: by the native process each maund of juice affords six seer of *gúr*.

100 parts of each sort treated simultaneously gave the following results:

| | No. 1. | No. 2. | No. 3. |
|---|---|---|---|
| Hygrometric moisture, on drying at 212° | 2.5 | 2.1 | 3.6 |
| Carbonaceous and vegetable matter, on calcination, | 1.8 | 2.1 | 4.0 |
| Carb. lime from digestion in nitric acid and precipitation by carb. pot. (No.3 alone effervesced,) | 1.6 | 0.6 | 3.9 |
| Alkaline salt dissolved, | 1.0 | 1.1 | 0.3 |
| Silex and alumina, | 94.1 | 24.1 | 88.2 |
| | 100.0 | 100.0 | 100.0 |

The earths were not further examined, but the two first consisted chiefly of sand, whereas the third was somewhat argillaceous. All three were of a soft fine-grained alluvium without pebbles: the analysis confirms the qualities ascribed to each of the specimens.

2. *Slaty anchracite from the hills south of Fatehpur in the Hoshangúbád district, Nerbudda; transmitted to Government by Captain J. R. Ouseley.*

A heavy dull slaty coal, splitting into laminæ marked with ferruginous oxide; colour brownish grey, inclining, where rubbed, to the lustre of graphite: streak brown: specific gravity 1.880.

Exposed to a red heat, burns without flame, and leaves a very copious red ochreous ash. It is of a poorer description than most of the Indian coals, although evidently connected with the same deposit as the *Towa* or *Burhanálá* coal, included in the table published in the GLEANINGS, vol. iii. p. 283, and described further in page 293;—which left only 15 per cent. of ash. Richer coal doubtless accompanies these upper shales. Captain OUSELEY has traced the deposit farther south to *Tumáni* near *Bhawergarh*, but no specimens have yet been furnished from the latter place. The composition of the Nerbudda coal is as follows:

| | |
|---|---|
| Water, separated on sand-heat, | 3.5 |
| Volatile matter, not inflammable, | 10.5 |
| Fixed charcoal, | 22.0 |
| Red earthy residue, | 64.0 |
| | 100.0 |

3. *Peat of the Calcutta Alluvium, dug up from 30 feet below the surface, at the Chitpúr Lock-gates.*

| | | |
|---|---|---|
| Composition— | Volatile matter, principally aqueous, | 62.0 |
| | Fixed carbonaceous matter, | 16.7 |
| | Red ash, | 21.3 |
| | | 100.0 |

*4. Bell of St. John's Cathedral, Calcutta.*

The great bell of this church, whose jarring and discordant sound has more than a million times reminded the neighbourhood of its cracked condition, has at last been removed, and a new bell is about to be founded to supply its place, under the superior skill of an eminent Engineer officer. The metal of which the old bell was composed turns out to be of a very brittle nature, and it is not surprising that it should have cracked (as recorded) under the effects of a *zor-se-tan* injunction from the delighted minister to the sexton, when it was first set up: it has a specific gravity of 8.887, and consists, in a hundred parts, of—

| | |
|---|---|
| Copper, | 67.0 |
| Tin, | 25.0 |
| Zinc, | 8.0 |
| | 100.0 |

*5. Ancient Copper Spear-heads, from Agra.*

An article in one of the English journals of science, some months ago, having mentioned, that on analysing ancient weapons of copper, found in Germany, the metal was found to be hardened with tin*; I was induced to examine some of the ancient spear-heads, which are frequently dug up in the neighbourhood of *Etáwa*, and are referred by the natives to the period of the *Mahábhárat* war. Some of these presented by Mr. Cracroft to the Benares Lit. Soc. are described in the Oriental Magazine, for December, 1826.

Three of them were examined: the exterior colour of all was that of unmixed copper.

No. 1. An *arrow* head, (so called) broke with a purple granular fracture: spec. grav. 8.459 at 85°.

No. 2. A similar weapon, broke with less facility, and had a better grain: spec. grav. 8.801.

No. 3. A spear-head, or kind of sword-blade, true copper colour and texture: tough; spec. grav. 8.835.

Very slight traces of tin were discovered on solution in nitric acid, but not ponderable, and rather proceeding from slight impurity of the metal worked up than from intended mixture—no traces of silver or lead were found. The difference of specific gravity was perhaps due to the brittle texture of the first specimen, and to the sword-blade having been fashioned under the hammer.

*6. New Patent Sheathing Metal for Ships.*

A patent has lately been taken out in England, for a cheap *marine metal* or metallic sheathing, stated to be compounded of lead, antimony, and mercury, which seems to have succeeded in the only object which

* Brande's Journ. xx. p. 296.

ever could have been aimed at by its inventor; that of gulling those who were foolish enough to put their trust in it. The following facts give authentic testimony of the worthlessness of the invention :—

"The Renown, a new ship built at Port Glasgow, her first voyage to India, was sheathed with this metal; she had scarcely been at sea a month before the sheathing showed a rough and unclean appearance like a piece of wood which had been long in the water, but without the grass to it, and this kept going on worse and worse: and it was observed from the bowsprit, when the vessel pitched, that in many places it hung from the bottom like pieces of rags; in some places large pieces were entirely gone, and what remained shewed every symptom as if it would soon follow, which it did: on examination of the pieces which came off, they appeared spotted, as if oxidizing fast into small holes; by the time the ship arrived here many hundred sheets were gone from the bottom, and what was left as far as could be seen was very unclean."

The metal in fact is nothing but a soft pewter, consisting of 95 parts of lead, and five of tin mixed with some antimony. Its specific gravity of 11.130 corroborates this analysis. No trace of mercury could be discovered by heating it in a retort to a temperature at which this metal would have risen in distillation.

The invention may have been suggested by an American patent taken out in London in 1831 for a sheathing metal of zinc and copper, combined in the proportions of 95 zinc to 5 copper. This compound, although superior to the pewter on account of its stiffness, would probably be liable to corrosion much more rapidly than copper; the inventor however states that the addition of a small portion of copper greatly diminishes this liability, and adapts it well for the sheathing of ships and other purposes.

Zinc by itself corrodes very rapidly in a damp climate. A remarkable instance of this was witnessed not long since, in removing some slabs of spelter which had been stored on the floor of a godown belonging to Messrs. COCKERELL and Co. The lowermost slab was converted into a solid white substance throughout, apparently crystalline in its structure; specific gravity 3.0. On heating in a test tube per se it disengaged much water and became yellow; it dissolved with moderate effervescence in nitric acid. It was therefore a hydrated carbonate of zinc, or perhaps rather a mixture of hydrated oxide and carbonate, agreeing closely with the mineral from Bleyberg in Saxony, described by SMITHSON* as *hydrous carbonate*, a sub-species of *calamine*, which he states to be a stalactitic formation. This is a remarkable instance of the formation of a natural insoluble mineral by artificial, though unintentional, means.

* THOMSON'S Chemistry, iv. p. 483.

*7. Argentiferous Galena, from the Bor Khamti country, on the sources of the Irawádí river.*

A small specimen of this ore, received from Mr. Bruce of *Sadiya*, in Asam, was found to contain one-fifth per cent. of silver: or after expelling the sulphur the lead would contain one-fourth per cent. This would hardly pay the expence of extraction, but the specimen was too small to give a fair average. The ore is however very valuable for the lead alone, yielding from 60 to 70 per cent. of that metal.

At *Brahmakund*, in Asam, from Mr. Bruce's specimens, occurs a very fine white porcelain clay, which mightbe turned to use were there any demand for fine pottery in India, and were the locality a little more accessible.

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## IX.—*Earthquake of the 26th August.*

The daily papers have published notices of this phenomenon, as observed at a great many places in the interior of India, with more or less detail, from which the following general facts may be gathered:—

The direction of the vibration was from north-east to south-west: there were three principal shocks; the first about half past six P. M. the second at half past eleven; and the third or most severe shock, at about five minutes to twelve (Calcutta time). In the places where it was most felt slight and continued vibrations seem to have been experienced for the whole of the day following. As the time of the second vibration was accurately noted in Calcutta by the stopping of an astronomical clock, we may assume it as the best point of comparison with the times noted at other distant points. Applying the difference of longitude, a few of them may be thus classed.

| | Observed h. | m. | | Diff. Long. m. | | Cal. Time. h. | m. | |
|---|---|---|---|---|---|---|---|---|
| Katmandú, Nípal, second shock, | 10 | 45 | + | 12 | = | 10 | 57 | very severe; loud noise. |
| Rungpúr, ditto | 11 | 20 | — | 2 | = | 11 | 18 | many houses injured, do. |
| Monghyr ditto, | 11 | 27 | + | 7 | = | 11 | 34 | walls cracked, noise heard. |
| Arrah, ditto | 11 | 15 | + | 14 | = | 11 | 29 | walls injured, do. |
| Under Rotas hills, ditto, | 11 | 10 | + | 20 | = | 11 | 30 | |
| Gorakhpúr, ditto, | 11 | 20 | + | 19 | = | 11 | 39 | walls cracked, &c. |
| Allahabad (vague), ditto, | 11 | 0 | + | 28 | = | 11 | 28? | hollow sound from river. |
| Bankúra, ditto, | 11 | 30 | + | 4 | = | 11 | 34 | none such since 1814. |
| Calcutta, ditto, | | | | | = | 11 | 34 48 | no injury done. |

At Monghyr, Rungpúr, Mozufferpúr, Mallái, and other places within the direct line of influence, many houses were destroyed or injured, and the alarm was great. At Katmandú, however, the following extract of a letter from Dr. A. Campbell, dated the 28th inst. will shew that the consequences were more serious, and judging from the course of the phenomenon we may reasonably fear some dreadful catastrophe towards Lassa on the north of the great Himálayan range.

" On the evening of the 26th, about 6 o'clock, the valley and neighbouring hills were visited by a severe shock of an earthquake: it lasted about 40 seconds, and during its continuance, there was a distinctly audible noise as of ordnance passing rapidly over a drawbridge. It seemed to me to come from the east, and I felt that it was travelling with the speed of lightning towards the west, and just under my feet: the houses shook most violently, and trees, shrubs, and the smallest plants were set in motion, not shaking but waving to and fro from their very roots. No damage was done to life or property. At ¼ to eleven we had a similar shock in severity and duration, and at eleven a most tremendous one. It commenced gradually, and increased until the houses, trees, and every thing on the face of the ground seemed shaken from their foundations. The earth heaved most fearfully, and when the shock was at its worst we heard the clashing of falling tiles and bricks in every direction ; and to add to the impressiveness of the scene, a general shout rose from the people in all directions. The murmur of human prayers was carried audibly from the city to our grounds (a mile), and nothing could be more imposing and vast than the scene. In a dead calm the noise of a hundred cannon burst forth : full grown trees bended in all directions, and houses reeled about like drunken men. In our grounds no lives were lost, but in Katmandú 19 persons were buried under the ruins of their own houses, and in the towns of Bhatgaon and Patan, many more. This great shock continued for nearly a minute, and during the following hour there were six distinct and strong shocks, the ground in the intervals being scarcely if at all steady ; and from this time till yesterday morning there were upwards of 20 distinct and sharp shocks. The loss of property has been very great, 125 houses fell in Katmandú during the night of the 26th, and nearly as many more have been levelled with the ground. Up to this time, in consequence of the torrents of rain that have come down, finishing the work of destruction commenced by the earthquakes, the city and towns have been evacuated, men, children and women of the *purdah,* rich and poor, have been and still are on the plains about the towns. Innumerable temples have been destroyed, and the *very gods of them* have been crushed to atoms. A fine and large brick temple (100 feet high), built in imitation of the great one at Jaganath, came down by the run early yesterday morning, and two fine pillars built by Bhim Sen were demolished by the great shock. All yesterday and last night we had occasional small shakes, and we are still in a state of suspense regarding the finale. In 1829, daily shocks continued to occur for 40 days, but none of them equal to the great one we had on the 26th."

A subsequent note from the same gentleman, dated the 30th instant, gives further particulars of this disastrous event :—

" We still continue to be revisited by occasional shocks of earthquake, all less violent than the great one of the 26th, but sufficiently alarming. This morning, when at breakfast, we had rather a sharp one : they all seem to come from the same direction ; that is from the east and north-east. The places east of Katmandú have suffered most : Bhatgaon, a large town, has been almost entirely destroyed ; upwards of 1000 houses have been levelled with the ground, and few have escaped serious injury. 300 souls have perished in this town (Bhatgaon) alone, and the total number of lives lost throughout the valley, as yet ascertained, is estimated at 500. The unfortunate people in many instances are in sore distress ; their stores of grain being buried beneath the ruins of their late dwellings, and without money to purchase other food. The grain shops, as well as all others, are shut, and the people dare not return to their houses, but remain without sleep or shelter in the open air, under torrents of rain. The house of Matabar Sing, (a goodly modern mansion) is quite destroyed, and the large garden houses of Bhim Sen, and his brother, Rau Bir, are rendered, for the present, untenable. Scarce a large house in Katmandú has escaped serious injury. The fort at Chíropaní, on the road to this from the plains, is much injured, and almost all the Government buildings have sustained great injury."

A. C.

*Meteorological Register, kept at the Assay Office, Calcutta, for the month of August, 1833.*

| Day of the month. | Barometer reduced to 32° Far h. At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Thermometer in the Air. Minimum at 4½ A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | Depression of moist-bulb Thermometer. At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | Hair Hygrometer. At 10 A. M. | At 4 P. M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ,512 | ,571 | ,505 | ,587 | 81,1 | 84,7 | 85,6 | 85,0 | 82,8 | 2,3 | 3,5 | 2,8 | 3,2 | 99 | 98 | | S. | S. | s. e. | wet. | hazy. | cloudy. |
| 2 | ,532 | ,548 | ,516 | ,565 | 82,0 | 84,3 | 80,0 | 84,9 | 83,1 | 2,0 | 3,8 | 5,5 | 5,4 | 95 | 91 | | S. | s. w. | s. w. | cum. nim. | cum. | do |
| 3 | ,542 | ,580 | ,498 | ,545 | 81,5 | 84,1 | 90,2 | 88,4 | 85,0 | 4,2 | 4,3 | 5,8 | 4,3 | 94 | 92 | | s. w. | s. w. | s. w. | nimbus. | cloudy. | cir. strat. |
| 4 | ,508 | ,580 | ,500 | ,552 | 80,2 | 83,0 | 90,0 | 87,5 | 85,2 | 2,2 | 4,0 | 4,5 | 3,8 | 96 | 95 | | s. | s. | s. | strat. | do | do |
| 5 | ,495 | ,571 | ,503 | ,534 | 83,0 | 82,5 | 90,4 | 87,2 | 80,1 | 3,9 | 3,2 | 4,1 | 1,6 | 97 | 96 | 0,90 | s. w. | s. w. | w. | nim. | do | rain. |
| 6 | ,509 | ,564 | ,431 | ,510 | 80,0 | 83,5 | 88,8 | 85,6 | 84,0 | 4,4 | 4,0 | 3,7 | 4,4 | 94 | 94 | 1,45 | S. | s. w. | s. w. | haze. | nimbi. | nimbus. |
| 7 | ,454 | ,500 | ,461 | ,482 | 82,0 | 84,5 | 91,4 | 87,7 | 85,2 | 4,6 | 4,4 | 5,1 | 4,6 | 94 | 93 | | W. | s. w. | s. | nim. | light. clds. | cirri. |
| 8 | ,447 | ,512 | ,450 | ,482 | 82,6 | 85,4 | 93,6 | 88,7 | 85,5 | 4,8 | 5,5 | 6,5 | 4,1 | 91 | 90 | | S. | s. w. | s. w. | haze. | hazy. | nimbus. |
| 9 | ,467 | ,552 | ,484 | ,565 | 85,0 | 84,5 | 88,1 | 86,6 | 85,0 | 3,6 | 3,8 | 3,7 | 4,4 | 94 | 95 | | o. | n. w. | n. e. | do | do | cir. strat. |
| 10 | ,544 | ,545 | ,528 | ,593 | 81,2 | 85,3 | 96,7 | 88,7 | 80,8 | 4,2 | 4,3 | 4,2 | 3,1 | 95 | 95 | | w. | n. w. | s. e. | do | cir. strat. | nimbus. |
| 11 | ,569 | ,604 | ,477 | ,556 | 80,7 | 86,3 | 98,2 | 90,5 | 81,2 | 2,3 | 4,0 | 5,8 | 4,0 | 95 | 91 | 0,25 | o. | s. | s. e. | do | cumuli. | do |
| 12 | ,494 | ,538 | ,460 | ,532 | 82,2 | 87,2 | 94,6 | 85,7 | 83,0 | 3,1 | 3,6 | 4,4 | 2,6 | 95 | 96 | 0,15 | o. | n. | s. e. | clear. | nimbi. | do |
| 13 | ,494 | ,550 | ,474 | ,550 | 82,3 | 86,3 | 92,2 | 87,6 | 81,0 | 2,0 | 4,2 | 4,7 | 2,0 | 95 | 95 | | o. | n. e. | e. | do | cum.strat. | cloudy. |
| 14 | ,546 | ,636 | ,584 | ,669 | 81,8 | 84,3 | 83,2 | 86,0 | 82,2 | 2,6 | 3,7 | 3,7 | 3,9 | 97 | 95 | 0,35 | o. | s. e. | s. e. | strat. | overcast. | nimbus. |
| 15 | ,626 | ,682 | ,600 | ,658 | 79,6 | 85,0 | 88,0 | 85,9 | 82,3 | 1,5 | 4,0 | 4,7 | 3,3 | 95 | 94 | 1,35 | s. | s. w. | s. | fair. | float.nimb | storm. |
| 16 | ,591 | ,643 | ,552 | ,598 | 82,1 | 83,5 | 88,3 | 85,2 | 82,3 | 3,9 | 3,5 | 3,5 | 3,4 | 96 | 95 | | S. | S. | S. E. | overcast. | nimbi. | nimbus. |
| 17 | ,566 | ,585 | ,523 | ,576 | 82,2 | 83,9 | 88,8 | 81,4 | 78,9 | 3,5 | 3,3 | 2,7 | 2,0 | 96 | 97 | 1,50 | S. | S. | o. | scud. | cir. strat. | do |
| 18 | ,513 | ,588 | ,528 | ,603 | 78,2 | 83,8 | 89,3 | 85,0 | 81,5 | 1,9 | 3,4 | 3,8 | 2,8 | 97 | 94 | | s. | s. w. | s. e. | cum. str. | cumuli. | clouds. |
| 19 | ,551 | ,618 | ,544 | ,585 | 80,2 | 84,1 | 91,0 | 84,8 | 81,1 | 2,0 | 3,4 | 3,4 | 2,3 | 95 | 97 | 1,15 | o. | n. | n. e. | do | cloudy. | drizzling. |
| 20 | ,529 | ,584 | ,522 | ,563 | 79,4 | 82,1 | 86,9 | 83,7 | 81,2 | 1,6 | 2,8 | 3,7 | 3,0 | 97 | 96 | | o. | s. | s. e. | do | do | nimbus. |
| 21 | ,530 | ,545 | ,472 | ,535 | 79,3 | 83,5 | 88,7 | 86,1 | 79,8 | 2,3 | 3,3 | 5,4 | 2,7 | 97 | 91 | 0,15 | s. e. | s. e. | s. e. | rain. | cum.strat. | do |
| 22 | ,473 | ,539 | ,485 | ,559 | 79,4 | 83,5 | 87,0 | 84,2 | 81,4 | 2,0 | 3,3 | 3,2 | 3,4 | 97 | 96 | 0,40 | E. | S. E | S. E. | cloudy. | nimbi. | cloudy. |
| 23 | ,486 | ,609 | ,566 | ,660 | 79,2 | 85,7 | 89,3 | 86,2 | 82,2 | 1,7 | 3,6 | 4,0 | 3,9 | 97 | 95 | | E. | S. E. | E. | do | do | stratus. |
| 24 | ,652 | ,715 | ,612 | ,683 | 79,1 | 85,0 | 91,7 | 89,6 | 81,1 | 3,7 | 4,0 | 7,2 | 3,1 | 96 | 89 | | E. | S. E. | S. E. | clear. | cumuli. | fair. |
| 25 | ,651 | ,688 | ,603 | ,677 | 79,8 | 86,4 | 93,2 | 89,4 | 83,7 | 1,8 | 5,7 | 8,2 | 4,6 | 91 | 87 | 0,10 | o. | E. | S. | do | do | nimbus. |
| 26 | ,647 | ,653 | ,521 | ,642 | 80,4 | 88,3 | 94,8 | 90,3 | 83,0 | 2,3 | 7,2 | 8,8 | 4,0 | 89 | 85 | | o. | E. | S. E. | do | cir.& cum. | fair. |
| 27 | ,624 | ,671 | ,575 | ,647 | 81,0 | 86,8 | 92,6 | 89,1 | 82,4 | 3,2 | 5,0 | 6,5 | 3,5 | 94 | 90 | | e. | n. e. | S. E. | do | cumuli. | cloudy. |
| 28 | ,642 | ,687 | ,622 | ,711 | 81,0 | 87,5 | 91,8 | 86,5 | 82,5 | 2,5 | 5,3 | 5,2 | 3,3 | 93 | 94 | | E. | E. | S. E. | do | cum. strat. | rain. |
| 29 | ,655 | ,711 | ,624 | ,661 | 80,7 | 87,0 | 90,6 | 85,4 | 81,3 | 2,6 | 5,0 | 4,5 | 2,3 | 94 | 96 | 0,25 | E. | s. e. | E. | do | nimbi. | cloudy. |
| 30 | ,627 | ,670 | ,541 | ,576 | 81,0 | 86,1 | 92,6 | 89,3 | 84,3 | 2,0 | 4,3 | 5,1 | 4,0 | 93 | 91 | | s. | n. e. | S. E. | cir. cum. | cum. strat. | do |
| 31 | ,530 | ,557 | ,433 | ,400 | 82,6 | 87,5 | 90, | 87,8 | 81,5 | 2,6 | 4,3 | 4,7 | 3,0 | 95 | 94 | 0,15 | S. | n. | n w. | misty. | cumuli. | threatening. |
| Mean | 29,548 | ,599 | ,520 | ,582 | 81,0 | 85,0 | 90,2 | 86,8 | 80,5 | 2,8 | 4,1 | 4,9 | 3, 4 | 96 | 93 | 8,15 | calores and variable. | | | rain less than average. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the Laboratory, the Barometer used at those hours stands ,044 lower than the Surveyor General's, the correction for the other Barometer will be given hereafter.

On the 26th, three shocks of an earthquake were felt in Calcutta, the first at about 6h. 40m. P. M. the second stopped an astronomical clock at the Surveyor General's Office, (vibrating N. and S.) at 11h. 34m. 48s. P. M. mean time. The severest shock was at 11h. 57m. P. M.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 21.—*September*, 1833.

### I.—*An Inquiry into the Laws governing the two great powers, Attraction and Repulsion, as operating on the Aggregation and Combination of Atoms. By* Julius Jeffreys, Esq.

Though the causes of the three states of matter, as they are called, that is to say, the solid, the liquid, and the aeriform, together with those causes by which the union of the different kinds of matter in compound bodies is effected, and those also by which bodies are expanded, contracted, or preserved of the same magnitude are subjects of great curiosity and importance, yet they belong to a branch of Chemistry which is at present in an unadvanced and imperfect state. Those justly celebrated philosophers who have done honor to our age by their discoveries in other branches have not yet carried their examination so far into this part as to arrive at any settled opinions concerning it, and not unfrequently in the same author doctrines have been advanced which are irreconcilable with each other.

The branch of natural philosophy to which the present inquiry is devoted having continued, with little advance, since it was written, in the year 1822, the doctrines I have endeavoured to establish, and the body of arguments by which they are supported, maintain still whatever of novelty or importance they may have possessed. As, however, in so considerable a period, a few of the arguments may have been brought forward by others, though not perhaps similarly applied, I have thought it proper to mark by including brackets, thus [ ], such parts as have undergone any alteration upon a revision. The body of the work remains *verbatim* as when first written.

Whether by directing my attention to this part of Chemistry I have been enabled to suggest any such modes of reasoning as may be applied to the advantage of the science, it would be presumption in me to pronounce an opinion. The question must depend upon the strength of the arguments which I use, and which I now submit to the judgment of the philosophic public.

## PART I.—*Of Attraction.*

Attraction is usually divided into two kinds.

The first of them GRAVITATION, or that by which bodies have a tendency to approach each other, and on which the sciences of Mechanics and Physical Astronomy depend. The second CONTIGUOUS ATTRACTION, or ATTRACTION of ATOMS, by which the atoms of bodies are kept in connection with each other, and which alone it is my province at this time to consider.

Contiguous Attraction, by a division subordinate to the former, is usually considered as comprehending two species, *Attraction of Aggregation,* or the attraction existing between homogeneous atoms, and *Chemical Attraction,* or that which is between heterogeneous atoms.

This distinction has arisen from a supposition, that similar particles exert an attraction towards each other which obeys laws different from those of the attraction between dissimilar particles. That such is an unnecessary distinction might be inferred, were there no other, from this consideration, that when one solid combines with another to form a compound solid, it is not possible to make a distinction between the attraction uniting its compound particles and the affinity by which the constituents are united. Thus in sulphuret of iron the cohesion of the iron and the sulphur is overcome by their mutual attraction which forms them into compound particles, and these again cohere in a new solid differing entirely from either of the former. The attraction which keeps the particles of the sulphuret in a state of aggregation cannot be distinguished from that which brought their elements together; for it favors the union of the elements, and aids in preventing their separation.

With reference to this and other differing opinions relative to contiguous attraction, I propose to begin this Essay by a somewhat minute examination of it under the following heads. 1st. By inquiring into the distance at which it operates; whether it is confined to near particles only, or extends to more remote ones. 2ndly. By inquiring how far the attraction of atoms is general; that is, whether all atoms in nature attract, and are attracted by all, or whether attraction between atoms (chemical and cohesive) is confined to a limited number. 3rdly. By inquiring into the effect of mass on contiguous attraction;

that is, how far the attraction between atoms (chemical and cohesive) is increased towards any given atom by the mass.

4thly. In what ratio of the distance the force of attraction of atoms varies; which will lead me to confirm by arguments the opinion that gravitation and contiguous attraction are the same property of matter, differing only in the circumstances under which it is presented to our observation.

1*st*. *Of the distance at which attraction of atoms operates.*

From the effects of cohesive attraction being in most cases evident only at very small distances, and from the particles of bodies in the aerial state actually appearing to repel each other, it has been generally inferred that this force is exerted only at very limited distances; and hence its name, contiguous attraction.

Although the effects of cohesive attraction may be *apparent* only at very small distances, yet it is scarcely correct to infer that this force is *exerted* only at such distances until due attention has been paid to the causes, which, by affecting the phenomena, may create deception upon the mind. These appear to me of two kinds,—the minuteness of attracting atoms, and all causes which operate *against* the attraction of atoms.

On the magnitude of atoms must in a great measure depend the greatest distance at which the force of their attraction is sufficiently powerful to be apparent.

If it be admitted that the force of this attraction decreases in as great a ratio of the distance as that of gravitation, then, since atoms are so small as not to be perceptible to our senses, it will follow that however strong their attraction may be when almost contiguous to each other, it will not be apparent at any mensurable distance, though in fact, it may be exerted in some degree at unlimited distances; for if two attracting particles of matter were sufficiently increased in magnitude without altering at all the laws of their attraction, this force might be evident at any distance however great, unless it be supposed (which would indeed be very unphilosophical) that attraction ceases at some certain distance suddenly and abruptly.

The other causes which may create deception as to the distance at which this attraction is exerted, are all powers which oppose its force. From the attraction of particles being constantly opposed by the powerful agency of heat, its force in liquids is scarcely apparent, though in fact it may be very powerful, for it is only the excess of the attraction over the repulsion that can be measured.

The two following are proofs of attraction in liquids, and also that it is very considerable*.

Sir HUMPHREY DAVY remarks very justly, " Cohesion is usually said to act only at the surface of bodies, or by their immediate contact, but this does not seem to be the case. It certainly acts with much greater energy at small distances ; but the spherical form of minute portions of fluid matter can only be produced by the attraction of all the parts of which they are composed for each other ; and most of these attractions must be exerted at sensible distances." To this remark, I may be allowed to add, that the attraction between the particles of a liquid, must, moreover, be a very powerful force; for it is not only able to resist the force of repulsion, but also to gather the particles into drops against their tendency to gravitate.

Another proof of the force of attraction in liquids, appears to me afforded in the fact, that the expansion of liquids increases in a greater ratio than the temperature, or that liquids expand more from equal additions of heat at high than at low temperatures. If the pressure of the atmosphere were the only force opposing their expansion, liquids would expand less as the temperature increased ; for, as a liquid expands, since it presents a greater surface† either to the air or to the vessel containing it, it is pressed on with increasing force. But if the force opposing the expansion increases with the temperature, it is plain that equal additions of heat would produce less and less effect.

If these equal increments of temperature in liquids be considered to indicate equal additions of heat, as is the general opinion, the only means by which the increased ratio of expansion can be accounted for, it appears to me, must be sought for in a powerful attraction exerted between the particles of a fluid, by the decrease of which attraction, as the particles separate from each other, more effect is produced towards enabling heat to expand the fluid, than the increase of atmospheric pressure produces in *opposing* the expansion; so that the sum of the powers *opposing* expansion is a decreasing force, and hence the expansion itself will have an increasing ratio.

The nature and physical properties of gases, have especially induced most philosophers to consider the attraction of atoms as only acting

* Elements of Chemical Philosophy, p. 68.

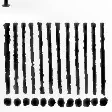
† This is of course the same effect; for though a liquid expanding in a jar may not have the surface exposed to the air increased, yet it displaces more and more air, and is re-acted on by the vessel, with precisely the same force, as if it were compressed on all sides by the atmosphere.

when atoms are very near to each other. From the great elasticity of gases, their atoms are treated of as beyond the sphere of mutual attraction, and some philosophers* have accounted for the expansion being equable for each equal addition of temperature, and for the ratio of expansion being the same in all gases, by the supposition of *no* attraction existing between their particles, and as proofs of the non-existence of any such attraction. How far this reasoning is correct let us presently examine.

The elasticity of a gas is certainly no proof of the absence of any attraction between its atoms. It serves only to show that the whole repulsion is very powerful and superior to any attraction that may exist between its atoms. Since the attraction between the particles of a gas is inferior to the repulsive power, it cannot be apparent, though it may yet certainly exist.

The gas will possess elasticity, and will expand unless subjected to a compressing force, such as the atmosphere.

Again, the equable expansion of a gas from each equal rise of temperature, is not any proof of the absence of attraction between its atoms on the ground usually taken, that if there were any attraction present, it ought, by decreasing as the atoms separated, and consequently offering less and less resistance, to allow of an increasing expansive effect from each equal addition of temperature. For it will presently be seen, that equal increments of temperature in gases by no means indicate equal quantities of heat, and therefore not equal additions of repulsive power. Neither does the atmospheric pressure offer constantly equal resistance to the expansion of a gas; since as a gas expands this force tending to compress its atoms must increase, for as the particles of a gas recede from each other, each is subjected to and has to support the pressure of a greater number of those of the atmosphere. Thus in the annexed figure



A B

the line A B may be supposed to mark the contact of the atmosphere, and a volume of subjacent gas. Here, each particle of gas with its elastic medium†, denoted by the dots A B, is subjected to the pressure of a column whose base is one particle of air.

A B

Let the gas be expanded by heat until the distance of the particles from each other is double. It is now clear, that each particle with its elastic medium (now greatly

* Murray, vol. i. p. 248, System of Chemistry. Berthollet, Chem. Statics. Lambert, vol. i. p. 116, 117, and 143.

† The seat of the repulsive force, according to most authors; as will be presently considered.

enlarged) has to support a column of air, the base of which is four particles, two being shown in the side view. Hence the atmospheric force tending to compress any two gaseous particles must increase as they recede from each other; and even very considerably, for aerial fluids expand much from small increments of temperature*.

[The experiments of Mr. DALTON, DE LUC, and others, made chiefly between the freezing and boiling points of water, lead to the conclusion that gases expand $\frac{1}{480}$ (of their bulk at 32°) with each accession of temperature of one degree (Farh.) in a simple arithmetical progression; and it appears assumed that this is the law of their expansion by heat. Hence air at 32° by an advance of 480 degrees, i. e. to 512°, would have its bulk doubled. Let us suppose two cubical pints of air to be taken; and let one of them be expanded to double its bulk, i. e. to a quart. Since the distance of the atoms increases as the cube root of the bulk; the bulk of one of these portions of air having become 2 to the other as 1; the distance of the atoms will have increased in the former in the ratio of the cube root of 2 to the cube root of 1, i. e. as 1.26 to 1 nearly; and since the number of atoms under a given surface of the gas expanded to a quart will be 100, while there are 158 under the same surface in the pint, and the pressure being constant on a given surface, 100 atoms of the former will have to support as much as 158 of the latter. Let the pressure be called 158. It is plain each particle of the quart will be pressed on by a force 1.58, while each of the pint will have to bear only a pressure of 1.

Again, since, as was shown by NEWTON, the mutual elasticity of the particles of air (and the same is assumed with regard to all gases), varies inversely as their distance, i. e. decreases in the direct proportion of their separation; and since the pressure increases as the square of their distance; the total absolute force expanding a gas must be in-

* The reader will not, it is hoped, think that the following error is here committed of supposing that by increasing the surface of a volume of gas the compression of its parts is increased; as for instance, that the compression of the parts of a spherical pint of gas (in which form the surface is the least possible) would be increased by moulding the volume into any other form, as that of a long cylinder, where the surface would be greatly increased. So long as the number of particles in a given volume is constant, the pressure and mutual re-action of the atoms will of course not vary, whatever may be the extent of surface exposed to the atmosphere or to any vessel it is contained in. But directly the number of particles in a given bulk, ceases to be constant owing to expansion, the pressure on each particle, of necessity must increase, whether it be a superficial particle contiguous to the air, or inside of the vessel, or a central one receiving the pressure from the other particles and re-acting against it.

creased in the direct ratio of the increase of the bulk.—Thus one cubic inch of air will need the absolute elastic power of each particle to be increased eight times, in order to expand it to 8 inches. The bulk having been increased eight-fold, the distance of the particles will be doubled (i. e. as the cube root of the bulk); on doubling their distance their elastic force is halved, i. e. from 8 it has become 4, and at the same time the pressure is increased as the square of their distance 2, and is therefore 4. Here then the elasticity and pressure balance each other, and the particles will be stationary. Hence the power endowing the particles with mutual elasticity must have been increased in the same ratio as the increase of the bulk. If these 480 degrees of temperature can double the bulk of a given volume of gas, they must double the whole absolute quantity of heat in the gas. The specific heat of the gas at 512° will be double that of the pint at 32° in the experiment. Now this is a point which probably no one acquainted with all that is known regarding caloric will maintain. We can hardly suppose that the whole specific heat of a gas at 32° (viz. that due to its capacity and temperature, and all the latent heat due to its gaseous state) is equal only to that introduced by the 480 degrees. Analogy would teach us, that it is, at least, three or four times as much. If then the 480 degrees of heat can effect as much expansion as the whole previously contained in the gas could, we are led necessarily to the conclusion that the latter is opposed, even in gaseous matter, by an attraction, so far as to have an effective repulsive force equal only to that subsequently introduced by 480 degrees of temperature, nay to much less, for the fact of the presence of this attraction being once established, between the gaseous particles, this force must be considered as operating against the heat subsequently introduced; and must lessen its effective power.]

[This argument I may illustrate in a more familiar manner. Let a cylindrical vessel half filled with any gas, nitrogen, stand inverted in a vessel of water, so that the liquid being on a level within and without the pressure on the gas shall be just that of the atmosphere. If the surface be two square inches, this will be equal to thirty pounds. Let an equal quantity of oxygen gas be added, and suppose it at first to remain under the nitrogen, and the vessel to be raised so as to preserve the same level in the water. The oxygen will now bear the whole pressure, and communicate the same to the nitrogen above it. Each will be pressed on with a force of 30 pounds. In the course of time, however, the two gases will become completely mixed. Each will occupy the whole vessel, the bulk of each being doubled; but the two together not filling more space than before. Now, it is clear, each presses on the water and each bears one-half of the pressure of 30 pounds, so that the elastic force introduced with the oxygen gas has enabled the nitrogen to double its bulk under the pressure of the air; and has done no more. If instead of adding the oxygen gas, heat had been added to the nitrogen until its bulk had been doubled by expansion, it is manifest the 480° which effected this would have introduced as great an *effective* dilating power as that of the whole specific heat of the oxygen gas in the other case. But it will not be contended, that the whole specific heat of the oxygen gas amounted to no more than 480 degrees: for analogy would lead us to conclude, that the latent heat due to its gaseous state (including that of the previous state of liquidity) must greatly exceed this quantity, and if we add all the caloric of temperature, in a substance of a large capacity for heat, from the natural zero up to the temperature of the experiment, we shall probably underrate the quantity at three or four times 480°. The question then is, whence does it happen that 480° of uncombined heat could aid the expansion of the nitrogen gas, as much as four times this quantity entering with the oxygen? A reason, it appears to me, can only be found in the following explanation. The latter heat is so far opposed by a mutual attraction between the atoms of the oxygen, that its free effective elastic power equals only that of the 480° in the other case.

If then any inference can be drawn from the equable expansion of a gas from equal increments of heat, it is certainly this; that a powerful attraction subsists between the gaseous atoms, reducing the elasticity of their large quantity of specific heat, in so great a degree, as to leave an effective elasticity equal only to what would be due to one-third or one-fourth as much heat. But the attraction cannot be apparent, because it is veiled beneath the excess of the elastic power.]

The alleged fact that all gases have the same ratio of expansion has also been proposed as an argument against the existence of attraction between particles in a gaseous state. It is said that all gases have the same ratio of expansion, because the force opposing expansion is the same in all, namely, the pressure of the air; and that if an attraction be admitted between the particles of a gas it must be considered as equal in every gas, for otherwise the ratio of expansion would not be the same in all, and hence that there exists no attraction, for it cannot be considered as equal in all gases. Mature reflection will perhaps induce a different view of the subject. Though a certain change of temperature may produce an equal change in the mass of all gases, yet the separation of the particles may be scarcely the same in any two, for we have no proof of different gases having the same number of particles in equal bulks.

In the combination of gases, a comparison between their prime equivalents, their proportions by volume, and the resulting bulks of the compounds, would lead to the conclusion that the number of particles in a given bulk differed materially in different gases. Thus, if it be assumed that in oxygen and nitrogen the number of atoms in a given bulk of each is equal, since one volume of the former combines with one of the latter to form the nitric oxyd gas, it would follow, that an atom of each unite to form each particle of the compound gas. If, then, in the latter, it be assumed, that in a given bulk the same number of compound particles exist as of simple ones in either of the former, it is clear that the two volumes ought in combining to condense into one volume, since two atoms form one compound particle. But experience shews that no condensation takes place. Therefore, whatever number of simple atoms have combined to form a compound particle, in the same proportion must the number of the latter in a given space have decreased.

Many other combinations of gases would prove equally hostile to the supposition, that all gases are at the same temperature and pressure equally dense. Hence, though equal rises of temperature may increase the bulks of different gases equally, the separation of the particles may differ in all. And further, the capacities of gases for heat differ materially. If equal bulks of hydrogen and olefint gases be taken, e
since their relative capacities for heat are as 1 to 1.7 nearly, we shall have these numbers representing the relative quantity of heat ~~by~~ due to
each degree of temperature. It would require 1.7 of heat to expand an equal bulk of hydrogen. Since the pressure on each is equal and increases equally, whence does this arise? We are compelled, I think, to conclude that atmospheric pressure is not the sole force opposing expansion, but that it is aided also by an attraction subsisting between particles in the gaseous state, more powerful in olefint gas than in hydrogen, whence to effect an equal expansion more heat is required in the former than in the latter.

If then any inference can be drawn from the equable expansion by heat of different gases, it is this, that in every gas an attraction subsists between the atoms; but in some gases, as might have been expected, more powerful than in others.

By the above elaborate inquiry, I trust I have shewn that the facts usually brought forward as evidence of the limited distance to which contiguous attraction is supposed to extend do in reality lead to an opposite conclusion.

Of an attraction between gaseous atoms, both similar and dissimilar, we shall have further satisfactory proof by the consideratiou of the following phenomena. In the transition of aqueous vapour to the solid state, a number of particles, which must have occupied a considerable space, convene to form a flake of snow.

This must surely have been produced by a general attraction throughout all the particles of that portion of vapour, the attraction between the contiguous particles being doubtless the most powerful. Hence each minute crystal of the flake is formed by the affinity of several neighbouring particles, but the aggregation of all the crystals to form the mass must be the product of an universal attraction of all the particles of the vapour. Otherwise no flake would be formed, but each grain would be precipitated separately. This instance alone appears a conclusive proof. Between dissimilar particles there are many like instances. The deliquescence of a salt has been adduced by Newton himself in proof of its attraction " acting at a distance" on the particles of vapour in the air.

The mutual action of the particles of different gases on each other is often evident at considerable distances, as when two gases combine to form a solid or liquid, such as the muriatic acid and ammoniacal gases, and many others.

If all these arguments and facts be admitted as true, sufficient has been said to prove that the attraction of atoms, whether of similar or dissimilar atoms, is not merely a contiguous force; and as we have had evidence of its being exerted by all atoms in a gaseous state, but have no proof of its ceasing at any point, it must surely be considered as a power that operates, though weakly, at a distance, and that it does not suddenly cease any where.

2*ndly*. *How far the attraction of atoms is general*, i. e. whether all atoms in nature attract and are attracted by all, or whether attraction between atoms, chemical and cohesive, is confined to a limited number.

It would seem to be the opinion of most modern philosophers, that all homogeneous atoms exert a mutual attraction when sufficiently near to each other, and hence that the particles of gases would cohere if brought within the limits of their attraction. That all homogeneous atoms attract each other, there is not any reason for doubting. It has been above shewn that we have no proof of a limit to the distance at which attraction may be exerted, and that even in the gaseous state all particles must be supposed to attract each other. Since then in liquids and solids also an attraction is always manifest, it follows that between homogeneous atoms this force is universal. We have equal reason to admit its action between all heterogeneous atoms, though it has until lately been considered to exist only between a limited variety.

The fact that many atoms refuse to combine may be readily explained, as Dr. MURRAY has observed, by taking all the forces that oppose combination into consideration. These forces may in many instances be superior to that of the attraction, and then the latter will apparently not exist. A very strong proof of the universal action of attraction between dissimilar atoms, and even when in the gaseous state, is afforded by the fact that all gases without any exception will either combine, or else mix, when brought together; and further that all dissolve water when placed over it*.

The reason of an attraction being universally apparent between all gases, though not between all liquids and solids, is *readily* explained. In the former state, the particles of the body are not detained by any cohesion, but exert an effective repulsion† for each other, which renders them easy to be put into motion; hence even a weak attraction exerted by another gas becomes evident. On the other hand, the particles of solids and of liquids, on a small separation from each other, are detained by their cohesion, it being stronger than the attraction of many bodies for them.

With respect to the attraction, which acts between atoms, I trust that under the present head sufficient has been shewn, to justify its being considered as a power, which is universal, i. e. which is exerted (though with various degrees of force) between all particles similar and dissimilar.

3*dly*. *The effect of mass on contiguous attraction.*

If the statements, laid down in the two former heads, be true, it follows of necessity, that attraction must also vary with the mass, or number of attracting atoms; and this is confirmed by experiment, with respect to heterogeneous atoms. Thus it is well known, that a particle of sulphuric acid has a stronger attraction for one of potash than one

* It is well known Mr. DALTON and others have endeavoured to explain these facts, without the assistance of an attraction. This will be *discussed in a future part* of this paper.

† I have used the term effective, here and elsewhere, to denote the excess of one force above its opponent; thus, if the attraction be 4 but the repulsion 10, the effective repulsion = 6. In like manner, there is in some cases an "effective" attraction.

of nitric acid has. Let the force of the former be 8, that of the latter 4. If a compound atom of sulphate of potash were in this case exposed to three atoms of nitric acid, the potash would be separated, by the united action of the three atoms of nitric acid. In the same manner, the sulphuric acid may be taken from sulphate of barytes, by an excess of potash, as Berthollet has shewn. In both the above instances, mass evidently operates*. There is also every reason for believing, that this attraction varies as the mass, between homogeneous atoms, although there are not experiments proving that this is absolutely the case; for such experiments can hardly be expected, nor is it easy to propose a way of making them. In a homogeneous solid mass, this law does not plainly present itself, merely from the smallness of the atoms; from which, as formerly observed, the attractions of all those that are at a distance from each other (which is the case with far the greater part) becomes so much less than that of contiguous particles, (on which the solidity chiefly depends,) as not to admit of measurement with it.

The law of attraction which is here enforced, is also perfectly conformable with the doctrine of definite proportion, and does not in fact at all affect it, as has been by some supposed.

From all that has been stated, it must surely be admitted as a law of this power, that the attraction of atoms varies as their number.

4*thly*. *The ratio in which the force of attraction varies, and the identity of this power, with gravitation.*

I have observed, at the beginning, that the opinions of philosophers, upon the attraction of atoms, are various, and in many instances contradictory to each other. They are particularly so in the present question.

Among other theories is that of Boscovich, which is very generally known. In this it is supposed that atoms do not exert a simple power of attraction towards each other; but that their mutual attraction alternates with a mutual repulsion, not with variations of time, (as has been by some supposed of the affinity of bodies for light) but with variations of distance. Thus that two atoms, when contiguous, repel each other with great force: and that this repulsion decreases with the increase of the distance, and at last vanishes, giving place to an attraction, which increases with the distance to its maximum; whence it decreases, vanishes, and is replaced by the repulsion, which obeys

* This fact does in no degree militate against the well established and important doctrine of definite proportions in combination.

the same laws. And that there are numerous alternations of these forces. According to this law, the particles of a mass must always remain at some one of the intervals between attraction and repulsion. This may be at various distances, and thus may be explained the various degrees of density, which the same body may possess at different times. To this hypothesis it may be objected that it cannot be easily admitted, of a *simple* force, that it should increase, as the centres of attraction are separated; much less then, that this force should suddenly, from a certain point, obey an opposite law, and decrease with an increase of distance.

But to admit, in addition to this, that the same atoms, from another certain point, exert an opposite force of repulsion, which obeys the same complicated law, and that these alternations are frequently repeated, until at last a regular decreasing attraction prevails, is scarcely possible; since it does not accord with the extreme simplicity always observable in the laws of nature.

Moreover, it is not possible by this theory alone, to account for the gradual increase of volume which bodies undergo, without introducing the repulsive agency of heat.

Though there are, according to this theory, many points of distance at which particles may rest, it cannot *of itself* account, even for expansion, much less for liquifaction and vaporization. And again, if the agency of heat be added to it, on a reduction of temperature, bodies would not contract in volume, for their particles would necessarily be prevented from approaching, by that region of repulsion, at the limit of which they lay. This would involve the necessity of another extraneous agent, namely some compressing force. And thus the two alternate forces, assigned in the hypothesis, are ineffectual without the assistance of the other two, and with them are altogether useless; consequently it is not philosophical to suppose them.

An anonymous writer in the Encyclopædia Britannica* treats of cohesion as a force, which extending to a small distance, is within this distance, " little or not at all altered by slight compression, or expansion." And in another place he says, " it appears, that the force of cohesion cannot be supposed to vary much with the density, and it is therefore allowable to consider it as constant as far as its action extends." I have, under another head, I think proved, that this attraction must not be considered, as extending only to very small distances; and the arguments, adduced in support of this, also prove, that attraction is a decreasing force. These are, the increasing ratio

* Supplement, Art. Cohesion.

of expansion in liquids, and the equable expansion of gases from decreasing additions of heat. The former can only be accounted for, by supposing that its chief opponent force, the attraction, *decreases*. The latter also requires the admission of an attraction between all gaseous particles, and that this force decreases likewise. For, did it not decrease, gases (as it was there demonstrated) could not expand as much from certain additions of caloric of temperature, as from their specific heat, so much more in quantity.

In Dr. REES's Cyclopædia* we find another author, who expresses a very different opinion. "There is," he says, "an attraction, which is found to obtain in the minute particles, whereof all bodies are composed, which attract each other, at or near the point of contact, with a force much superior to that of gravity, but which, at any distance from it, decreases much faster, than the power of gravity."

And others, observing the apparently great decrease in the force of attraction, as particles are separated from each other, have supposed that it must vary as the inverse cube, or some higher power of the distance.

All these views have doubtless arisen, from attending to the apparent, rather than the actual, force of attraction. Since attraction, whenever presented to observation, is always opposed by a divellent force, the law of the simple force cannot be investigated by any direct experiment from its immediate effects.

There is however the strongest reason for concluding that contiguous attraction, as treated of in chemistry, is identical with the great universal power, gravitation.

This opinion has been hinted at by philosophers from an early age of this science, and among them by Sir HUMPHREY DAVY†. But it may be demonstrated, as I think, in the most satisfactory manner, from the following considerations.

1*st*. The great NEWTON has demonstrated, that the gravitation, which prevails throughout the bodies of the system, is composed of the sums of the attractions between the atoms of the several bodies. And thus it is, strictly speaking, an attraction of atoms; and it is exerted between the same atoms as the attraction, which usually bears that name.

2*ndly*. It will be found to possess the same properties also.—First. That attraction of atoms, which constitutes gravitation, increases or decreases as the distance at which it operates is less or greater. This

* Art. Attraction. † Sir H. DAVY's Elements of Chem. Philosophy, p. 68.

the same great author has shewn. For the attraction of a body in the mass (i. e. gravitation) depends wholly on this supposition. This same property we have seen* must belong to the other attraction of atoms. Secondly. The *absolute* force of gravitation varies as the mass. This, we have also seen†, must be a property of the attraction of atoms *chemically* considered.—Thirdly. By decreasing the mass, in gravitation, until the force operat~~ing~~ only between a few or single ed atoms, this force would become imperceptible at a very small distance, which exactly agrees with the attraction of atoms in question‡. Fourthly. It has been above§, I think, clearly shewn that the attraction of atoms, as conneeted with chemistry, is universal; and is therefore in this respect perfectly similar to the attraction of atoms named gravitation.

We have here two forces exerted by the very same atoms, (namely those of which all masses in nature are composed,) and possessing the same properties, as far as a comparison can be carried on between them; and this extending through numerous particulars; whence we may conclude, that both are the same force differing only in the accident of distance, from whence it has acquired distinct names—and therefore, since, by the above-mentioned discovery of NEWTON, the forces of atoms composing gravitation vary inversely as the square of their distances, this force must still obey the same law, when considered under the name of contiguous attraction.

The truth of this doctrine, which I have been endeavouring to demonstrate generally, will I think be placed beyond all question, by the consideration of the following case.

A celebrated author, whom I have already quoted, has adduced the spherical figure of a drop of water in proof of cohesion operating throughout all its particles. Let us now suppose such a drop, *situated in absolute space*, to be enlarged by an accession of matter, until it became an ocean. This ocean would unquestionably retain the figure of a sphere; its parts being kept together by the same force, not at all changed in quality, but only increased in quantity. From having been once a drop, it would become a planet, and its attraction, which was called cohesion, would now be considered as gravitation.

In addition to this, it may be remarked, that part of the fluid, passing into vapor, would form an atmosphere around the planet, (admitting that it was exposed to the usual source of heat.) The force, which detained this atmosphere on the surface of the planet, would constitute its gravitation, which would be no other than the cohesive

* Vide page 443. † Vide page 451, Head 3. ‡ Vide page 443. § Vide page 450.

attraction. And, since it operates between the liquid and gaseous atoms, most of which are at a much greater distance from each other, than any two neighbouring atoms of the vapor, it at once proves that atoms in a gaseous state attract each other at all distances.

### Part II.—*Of Repulsion.* Div. 1st.

Were the attractive force, which we have hitherto treated of, opposed by no other power, it is manifest, that the atoms of all bodies would be in perfect contact, and that all masses would be absolutely dense. Hence there must of necessity exist some divellent, or repulsive power in bodies; for the atoms of none can be in contact, since all are capable of contracting from certain causes. As they, in contracting, occupy a less space than before, the difference between their present and former bulks must have intervened between their atoms; and even much more; for no limit has been found to the contraction of bodies. It is owing to the same divellent power, that heterogeneous atoms cannot come into contact. Hence the limited number of combinations; and hence it happens, that most gases, on being presented to each other, merely mix, and cannot enter into combination.

Since a divellent or repulsive force is always as evidently operating to prevent the contact of atoms, as an attraction, exerted by them, is operating to favor their contact, the former has no less commanded the attention of philosophers, than the latter.

Any theory, which would at all admit of investigation, must suppose the great opponent force to the attraction of atoms to depend, either on a repulsive power inherent in and exerted by them; or on this force, aided by the power heat;—or on the power heat alone.

These I shall attempt to investigate severally.—*First.* Whether the opponent force to the attraction of atoms is a power inherent in and exerted by them.

The theory of Boscovich and a few others may be placed under this head. His theory, as above observed, would sufficiently account for the constitution of bodies, if their volumes were permanent, and their particles always at rest. But, since all bodies are capable of possessing every degree of density, and of expanding and contracting gradually, such a theory would interfere with known phenomena, which could not take place on the admission of it.

Bodies, as I have before remarked, would never expand without the introduction of some extraneous expanding power, nor could they contract, without the admission of a compressing force, of which we have no evidence, and the action of which could not be explained.

In short, as all powers inherent in atoms must be permanent, and as a permanent repulsion cannot alone account for densities and states, which are not constant, the power opposing attraction cannot be solely a power inherent in atoms.

*Secondly.* Whether the opponent force to the attraction of atoms depends on a power exerted by them, aided by the power, heat.

In a modern treatise on attraction* and repulsion, it is thus asserted :—" The states of elastic fluidity, solidity, and liquidity, in all of which the greater number of simple bodies are capable of being exhibited, at different temperatures, are not uncommonly conceived to depend on the different actions of heat only, giving a repulsive force to the particles of gases, and simply detaching those of liquids from that cohesion with the neighbouring atoms which is supposed to constitute solidity." And he adds, " but these ideas, however universal, may be easily shewn to be totally erroneous : and it will readily be found, that the immediate effect of heat alone is by no means adequate to the explanation of either of the changes of form in question." " There can never be rest, without an equilibrium of force, and if two particles of matter attract each other, and yet remain without motion, it must be because there exists also a repulsive force, equal, at the given distance, to the attractive force."

To this I answer.—It is undoubtedly true, that, to enable the particles of a body to be at rest, the opponent forces, operating on them, must be in equilibrio. And the remark, just quoted, might properly be objected to those writers who have treated of the force of attraction between the particles of solids, as being greater than the repulsion. But, since the question is, whether or not *heat* be the repulsive power which keeps bodies in the gaseous, the liquid, and the solid state, this remark cannot be considered as a proof on either side, since it has no reference to this question.

Admitting heat as the sole source of repulsion between atoms, its force may easily, nay must be considered, as equal to that of the attraction, whenever particles are at rest. The opponent powers must be in equilibrio, whether heat be the source of repulsion, or not.

In the same treatise also, *attraction and repulsion,* it would appear, are considered as being both exerted between atoms, at all distances within a certain limit. In the first place, it cannot be admitted as possible, that at the same distance, the same particles should at once attract and repel each other. But even supposing it possible ;—if this repulsion

* ENCYCLOPÆDIA BRITANNICA, Supplement, Art. Cohesion.

be equal to the attraction in the liquid state, since it must be a permanent force, the attraction, being always opposed by an equal force, would never be able, under any circumstances, to draw the atoms into the solid state.

If the repulsion be considered equal to the attraction, when particles are at rest in the solid state, no solid could contract, unless exposed to an extra-compressing force, of which (as before remarked) we have no evidence, and which must only operate at certain times, for otherwise no solid could ever expand.

Since then it has been shewn, that, if an inherent repulsion, exerted by atoms, be considered, as one of the great opponent forces to their attraction, it necessarily involves the introduction of an extra-compressing force, which must only operate at certain times; and since no such compressing force can be demonstrated, it is manifest that such a repulsion cannot be considered as one of the opponent forces to atomic attraction.

*Thirdly.*—That the opponent force, to the attraction of atoms, depends on the power heat alone.

It has been already proved, that no inherent force of repulsion can be supposed to be exerted by atoms, and that such a force would not account for the phenomena of repulsion, which could not take place on the admission of it. It therefore follows, according to the division, that in heat consists the great opponent force to the attraction of atoms.

It is manifest, that previously to an attempt to explain the action of heat, as the source of repulsion, a decided opinion should, if possible, be formed of its nature.

The difficulty of this is apparent, in the fact, that chemical philosophers are divided between the two opinions, that the phenomena called heat depend on vibratory motions in the particles of bodies, or that heat is a subtle highly elastic fluid pervading all bodies.

1. That the phenomena of heat depend on vibratory motions, in the particles of bodies.

The phenomena of heat are of two kinds:—Those, which are apparent to the senses, and commonly called heat; and those of repulsion. The great philosopher BACON, being unacquainted with most of the facts proving the repulsive force of heat, could only judge of its nature by those of the former kind. He, observing that great heat was produced by the friction and percussion of many bodies, that iron may even be rendered red hot by percussion, was led to the conclusion, that heat consists in a motion in the particles of bodies. But he did not apply his hypothesis to the explanation of repulsion. Of late years a great philosopher* has extended the views of Bacon, and has endeavoured to explain all the phenomena of repulsion by a vibratory and rotatory motion in the particles of bodies. This great and meritorious author writes in these words :—" When any body is cooled, it occupies a smaller volume than before, it is evident, therefore, that its parts must have approached towards each other ; when the body is expanded by heat, it is equally evident, that its parts must have separated from each other. The immediate cause of the phenomena of heat then is motion, and the laws of its communication are precisely the same, as the laws of the communication of motion." Since all matter may be made to fill a smaller volume by cooling, it is evident that the particles of matter must have space between them, and since every body can communicate the power of expansion to a body of a lower temperature; that is, can give an expansive motion to its particles, it is a probable inference, that its own particles are possessed of motion: but as there is no change in the position of its parts, as long as its temperature is uniform, the motion, if it exist, must be a vibratory or undulatory motion, or a motion of the particles round their axes, or a motion of particles round each other." And, he continues, " It seems possible, to account for all the phenomena of heat, if it be supposed, that in solids the particles are in a constant state of vibratory motion, the particles of the hottest bodies moving with the greatest velocity, and through the greatest space; that in fluids and elastic fluids, besides the vibratory motion, which must be conceived greatest in the last, the particles have a motion round their own axes, with different velocities, the particles of elastic fluids moving with the greatest quickness; and that in ethereal substances, the particles move round their own axes, and separate from each other, penetrating in right lines through space. Temperature may be conceived to depend upon the velocities of the vibrations; increase of capacity on the motion being performed in greater space; and the diminution of temperature, during the conversion of solids into fluids or gases, may be explained on the idea of the loss of vibratory motion, in consequence of the revolution of particles round their axes, at the moment when the body becomes fluid or aëriform, or from the loss of the rapidity of vibration, in consequence of the motion of the particles through greater space."

It is under the deepest impression of respect for the author that I allow myself to make my observations on the doctrine supported in the above quotation, which observations are only stated from a persuasion of the importance of one decided and general opinion as to the nature of heat in forming the science of chemical philosophy.

* Sir H. Davy's Elements of Chemical Philosophy.

It is certainly true, that when a body contracts on a reduction, or expands on a rise of temperature, in the one case the particles approach, and in the other recede, from each other. This approximation, and separation, is a gradual and regular motion. Thus, if two particles are kept at a certain distance from each other, by any force (whether of heat or not) on the removal of that force the particles must have motion, if they approach; but when they arrive the distance at which they are to remain, this motion ceases, and is no proof of vibratory motions in the atoms, nor can it give rise to them. When particles approach, they are put into gradual motion, by the force of attraction; and they will not separate, until a superior force urges them in a different direction.

Since the particles of matter have space between them, and since they exert great attractions for each other, the force, which keeps them asunder, must be equal to their attraction. If this force is a vibration of the particles, it cannot be permanent. No motion can be lasting, when opposed by any force, however small, unless it is preserved by an equal force. But the vibration of atoms would be opposed by a very powerful force, their mutual attraction; which would urge them into absolute contact; when any vibration must cease, from their impact against each other. It cannot be said, that their motion is kept up by that of neighbouring bodies, for the vibration of all particles in nature would very soon cease for the same reason.

The expansion, which a hot body produces, in one of a lower temperature, arises from the divellent power becoming superior to their attraction, and producing a slow and progressive separation of the particles of the latter, which power, as above shewn, cannot depend upon a vibratory motion, for any such motion must soon cease. And even could such motion last, it would not be increased by superior vibrations in another body, but lessened. If two vibrating bodies are brought into contact, their vibrations cease directly, from the one body being a mechanical obstacle to any motions in the other. But, if the motion in the one is greater, it will still more check any motion in the other, not only from the obstacle arising from its contact, but also from its increased impact, unless it be supposed, that the particles of the two bodies happen to be moving in the same direction, at the instant of their contact. This, which would involve the idea, that all particles in nature are always oscillating in the same direction, at the same moment of time, is moreover contrary to a supposition in the above theory, that bodies of different temperatures vibrate with different velocities, from which their atoms would soon move in different directions at the same time.

That the particles of solids are in a constant state of vibratory motion is incompatible with their mutual attractions, and their gravity. If temperature depended on vibration of atoms, bodies would soon have no temperature, (i. e. fall to natural zero,) for their particles would soon cease to vibrate.

This theory cannot explain temperature ; for bodies would lose their temperature if temperature be vibration. Nor capacity, if capacity be latitude of motion. Nor could radiation take place, if radiated heat be vibrations communicated through the air, for according to this theory, the particles of elastic fluids move with the greatest quickness. Thus, suppose the particles of any body A, are vibrating at any given rate 10, and those of another distant body B, at any less rate 8, as the air between them is vibrating with the greatest quickness, let its rate be 20. If the air vibrating at the rate 20 does not increase the rate of vibration in A and B, how can it transmit from A to B the small difference of their vibration ?—or how can it receive vibrations from A, which vibrates at a less rate than itself. And moreover, as matter of some kind must be present to transmit vibrations, radiation could not take place through a vacuum, as it is known to do, unless the " subtle medium" of Newton* be supposed to exist, which is not a part of *this* hypothesis, and which, as will hereafter be shewn, is very nearly allied to the "matter of heat" of Lavoisier.

That the repulsive force opposing attraction cannot be explained by vibratory motions, supposed to exist in the atoms themselves of bodies, has been, I trust, proved by numerous unanswerable objections.

2. That heat is a subtle, elastic fluid, pervading all bodies.

The doctrine of the materiality of heat has been adopted by the greater part of modern philosophers ; and the cause of its entering bodies, and separating their particles, has been explained in three ways:

*First.*—Boerhaave, with some other philosophers, attempted to explain the distribution of heat, solely by supposing that its particles are mutually repellent. Hence its perfect elasticity, which it was supposed would expand it equally through space, so that, in equal volumes of space, there would be equal quantities of heat, whether occupied by other matter or not. And hence he concluded that equal volumes of matter always would contain equal quantities of heat.

That this is not the case, is proved by experiment, for equal volumes of matter, it is well known, contain very different quantities of heat. Moreover, the argument itself is not sound ; for very dense bodies, between the atoms of which a powerful attraction subsists, would never

* Treatise on Optics, Query 18.

admit heat, until it was so accumulated in rare bodies, that their elasticity was superior in force to the cohesion of dense bodies, which is so far from being the case, that the elasticity of the atmosphere is evanescent in comparison with the cohesion of most solids.

*Secondly.*—In his Elements of Chemistry Lavoisier proposed another explanation of the action of heat, in these words :—" It is perhaps more natural to suppose, that the particles of caloric have a stronger mutual attraction, than those of any other substance; and that these latter particles are torn asunder, in consequence of this superior attraction of the particles of caloric, which forces them between the particles of other bodies, that they may be able to reunite with each other*."

This hypothesis, which treats of heat as a non-elastic substance, is liable to so many objections, that it has had very few advocates, and was probably relinquished by its great author. It is only necessary to remark one objection, which must have alone induced him to reject it. If the particles of heat had an attraction for each other so far superior to that apparent in the densest bodies, it is manifest, that it would not be diffused through all bodies, but would collect itself into masses absolutely dense, between the parts of which the atoms of no other bodies could possibly exist.

*Thirdly.*—That doctrine of the nature and action of heat, which has been much received of late years, and which was introduced by Dr. Cleghorn, is so satisfactory, and conformed so nearly to the phenomena of the actions and motions of heat, that it may be considered as the true explanation. This doctrine, as is well known, considers heat as a body, whose particles are mutually repellent, but attract those of all other bodies, with various degrees of force. Hence its perfect elasticity, and hence its presence in all bodies, but in various quantities in each.

Previously to making any further inquiry into the laws and action of heat, I propose to weigh the facts, which have been considered as objections to its materiality, and to state various arguments in proof of its materiality.

The following facts have been at various times opposed to the material doctrine of heat:

1. That, when many bodies are subjected to percussion, much heat is evolved. Iron may even be raised to a red heat. The explanation of this, which has been given by others, does not perhaps place the fact in quite so clear a light, as the following :—Since the force of cohesion in iron is very powerful, it is plain, that the heat between its

* Elements of Chemistry, translated by Kerr, page 72.

atoms must be compressed with great force, and must exert an equal repulsion. If the compressing force is suddenly increased, so also must the repulsion, the iron being somewhat condensed. But, when these forces become superior to the affinity, which detains the heat in the iron, it is manifest that part of the heat must leave the iron, and this will take place until the affinity for the remaining heat becoming very great, little or none can be evolved, and the density cannot be increased.—This explanation is verified by the experiment. Less and less heat is evolved, at every succeeding blow, until at last little or none can be driven out, and here condensation ceases.

2. That much heat is made sensible by the friction and attrition of many bodies.

Since the particles of heat attract so powerfully, the atoms of all other bodies, as to enter even the densest, much more then will they be accumulated on the surface of bodies, and endow them with a repulsive force. Hence the fact that two plates of glass cannot be brought into contact, as NEWTON has shewn*. But if two bodies, rubbing agaiuste ach other, have this superficial heat compressed, with a force superior to that which detains the *most distant* particles of it (which from their distance must be weakly attracted), it must happen, that part of the heat will be separated, while the friction lasts, and will be renewed as soon as it ceases. This explanation, which I have given of the fact, appears to render it perfectly conformable with the material doctrine of heat. As, in attrition, both the forces of friction and percussion on compression operate, there will be a double cause for heat becoming sensible, which has been just explained under the two former heads. The experiment of RUMFORD, in which much heat was evolved, in the boring of metal, and yet the parts torn off appeared to possess their former capacity, has been sufficiently explained by Mr. DALTON in these words:

"The fact is, the whole mass of metal is more or less condensed, by the violence used in boring, and a rise of temperature of 70° or 100° is too small to produce a diminution in its capacity for heat. Does Count RUMFORD suppose, that if in this case the quantity of metal operated on had been 1lb. and the dust produced the same as above, that the whole quantity of heat evolved would have been the same†?"

3. The fact, that heat is evolved, in the sudden change of gunpowder, by explosion from the solid to the aërial state, has been considered as an objection to this doctrine of heat; for this appears contrary to

* Treatise on Optics, Query 31.

† New System of Chemical Philosophy, page 98.

the known law, that in a change from a dense to a rarer state, heat is not evolved, but on the contrary becomes latent. Though this is almost an invariable law, in a simple change of any solid A, into a gas A; yet if in becoming gaseous, A undergoes a change into another gas, B, an absorption of heat is not a necessary consequence; for the heat in the solid A may be sufficient to keep B in the state of gas, or may even be more than requisite, in which case some heat will be evolved.

Thus the oxygen, in the nitre of the gunpowder, during the explosion combines with the carbon and sulphur. The carbonic and sulphureous acid gases may not require so much heat for their existence in the gaseous state, as is afforded by the solid oxygen; hence heat will be evolved. If the experiments of LAVOISIER and CRAWFURD may be admitted as at all correct, they will prove the justness of this explanation.

LAVOISIER inferred from his experiments, on the combinations of oxygen gas, that in nitre it retains $\frac{7}{8}$ of the heat, on which its gaseous state had depended. CRAWFURD has stated the capacity of oxygen gas, as much greater than that of any of its compounds, and hence $\frac{7}{8}$ of its heat will be more than sufficient to supply the latent heat of the carbonic and sulphureous acid gases, formed in this instance.

The late experiments of MM. CLEMENT and DESORMES, if correct, would show that the capacity of carbonic acid gas is equal or superior to that of oxygen, and would increase the difficulty of the explanation by making the one offered inadmissible. It must however be considered, that no conclusion can be drawn with regard to the habitudes of caloric from instances of sudden and violent chemical and mechanical action. Thus no small part of the heat may be liberated by the resistance offered by the air to the sudden expansion of the gases formed. Whence much heat that would have been latent became caloric of temperature at the moment of the explosion, and whatever was extricated would be readily absorbed again from the air on the diffusion of the gaseous products of the powder.

Again, in so great a chemical change we cannot from any established law affirm, *a priori,* that heat should be either liberated or absorbed. Admitting the *capacity* for heat of the gaseous products to equal, or even exceed, that of the gases condensed in the nitre of the powder, it does not all follow that the *latent heat due to the gaseous state* of the former should equal that of the latter gases; and these appear in nitre to retain this heat, though solidified by the intensity of the affinities.

[*To be continued.*]

II.—*On Progressive Development in the cold-blooded Vertebrata. By* D.W. Nash, *Asst. Surgeon, Beng. Est. A. L. S. Corresp. Member S. A.*

Among the many important considerations embraced by the theoretical department of geological science, the question of the gradual transition of fossil remains in the strata which form the crust of our globe,—the supposed development of the forms of organic life in a progressive and ascending series,—and the application by analogy of this hypothesis founded on actual observations of that which has been, to the phenomena which are daily recognized in the present state of things,—are subjects of the greatest interest to the geologist and naturalist, while to the cause of science in general their elucidation is of considerable importance.

On these questions the most eminent authorities among modern geologists are divided, and though not perhaps so violent in the expression of their opinions as the Neptunists and Plutonists of a former day, the advocates and opponents of the theory of progressive development have entered with no little warmth into this interesting controversy.

Mr. Lyell in his Principles of Geology, in speaking of the conclusions arrived at by Sir H. Davy from the consideration of geological data, expressly states, that, "the theory of progressive development of organic life from the simplest to the most complicated forms, has no foundation in fact."

On the other hand many observers equally high in scientific reputation have imagined that they see, not only in the fossil monuments of former worlds, the imperishable evidences of a state of things differing from, and antecedent to, that now under our observation,—but also in the organization of the present inhabitants of our globe, indisputable proofs of a progressive advance to perfection in the forms of organic life.

It cannot be denied that the fossil remains which have been observed in the different strata of the earth's crust, are arranged very nearly in the order which the animals to whom they belonged, occupy in the natural system of zoology;—that those genera which zoologists are agreed in considering as the least developed forms are found in the lowest or most ancient formations, and that, as we ascend from the primitive through the transition, secondary, and tertiary rocks, new and more perfect forms of life meet us at every step of the investigation.

Setting aside the consideration of the order in which the development of the invertebrate classes has proceeded, as embracing too wide a field and requiring a minute investigation of the anatomical relations of this vast class of animals, the cold-blooded vertebrata appear to offer the most convenient opportunity of observing the analogies which subsist between animals of the same type of conformation, but differing in the degree of perfection at which their various systems of organs have arrived.

It appears that at one period of the earth's history—that in which the deposition of the secondary formations was taking place,—circumstances were highly favorable to the development of the cold-blooded tribes of vertebrata. The oceans swarmed with enormous cephalopoda, with gigantic individuals of a saurian race which has long since vanished from the surface of the globe, but whose remains scattered in such profusion through the oolitic group furnish the zoologist with data which enable him to fill up many apparent vacuities in the scale of the creation.

Nor, as might have been expected, if we determine to admit the present as the only true standard by which to judge of the state of things in past epochs, was this form of organization chiefly peculiar to the inhabitants of the waters; the ancient continents contained animals of this type only; the megalosaurus and the iguanodon peopled the forests; the banks of the rivers and fresh-water lakes were frequented by crocodiles and huge salamanders, while the pterodactyli pursued their prey amid the palms, the *cycadeæ*, and the tree ferns, of the primeval Flora. But not until after the deposition of the great calcareous formation do we find any trace of the existence of a warm-blooded animal: not even the most strenuous advocates for the uniformity of the past and present operations of nature have been able to prove that animal life had progressed so far as the development of the class mammalia, or of birds, until after the epoch just alluded to.

The only exception to be made with regard to this statement is met with in three or four specimens consisting of fragments of the lower jaw of an animal which has been pronounced by the highest authority to have been a species of didelphis. This fossil, discovered in the Stonesfield slate, a member of the oolitic series, lying below the cornbrash and above the Bath oolite, contains nine similar acuminated molares, terminating in three elevated points; but as no living didelphis possesses this number of molar teeth on one side of the jaw, and as those of the didelphis present the characters of insectivorous teeth, it may be permitted to entertain a doubt as to the animal to which this specimen should be referred.

The shape of the teeth appear to indicate a carnivorous character in the animal to which they belonged, and bear a considerable resemblance to the molares of the seal.

Supposing this to be the case, the position of this fossil would not be, as Mr. Lyell imagines, as fatal to the theory of successive development as if several hundreds had been discovered, since its appearance is subsequent to the period in which the great Saurian reptiles were the most abundant; and should it prove to belong to the genus phoca or to some cetaceous animal, it would be an example of the commencement of the type of mammalia in one of the least perfect tribes of the order, and therefore an additional argument in favor of the theory it is intended to subvert.

In endeavoring to show that there actually does exist what has been called a stimulus of perfection in the organic world, it will be necessary to take a system of organs in its most imperfect form, and to investigate the steps by which nature has succeeded in effecting a series of gradual improvements.

Of the various functions conducing to the preservation of the individual, none is of more importance than that by means of which the oxygenization of the blood is effected, and this fluid rendered fit for repairing the waste of the body, and supplying materials for the growth and increase of the different organs. The development of the respiratory and circulating systems will necessarily be in a certain and constant ratio to each other, and, wherever we see a perfect respiratory apparatus, we have an indication of a proportionally complicated set of organs for the circulation of the blood, and consequently an increase in the irritability and nervous energy of the animal.

The respiration of the embryo in warm-blooded animals is at first solely cutaneous, and the heart consists of two cavities, both systemic, as no respiratory organs are developed. The systemic ventricle is then divided by a septum, and the right ventricle thus formed is prolonged into a tube which opens into the aorta subsequently to the origin of the branches which supply the upper portion of the trunk. This prolongation of the right ventricle is called the *ductus arteriosus*, and from it are given off small branches, which go to supply the lungs. The circulation is now that of a reptile, the heart in effect consisting of two auricles and a ventricle; but on the emergence of the animal from its fœtal state, the lungs become the immediate organs of respiration; the blood is more perfectly oxygenized; the irratibility of the animal increased; the ductus arteriosus is obliterated; its pulmonic branches alone give a passage to the blood, the whole of which, now undergoing the necessary changes in the lungs, is sent from the systemic side of the heart to perform its functions in the animal system.

There is now therefore a heart of four cavities, and a perfect system of respiration, in short, that of the highest type, birds and mammalia. The first appearance of that form of organization which runs through all the vertebrated classes is to be found in the most perfectly developed tribe of the invertebrata, the naked *cephalopoda*. The chambered and convoluted shell of the nautilus and the ammonite may be traced in the internal skeleton of the sepia, which consists of numerous concentric lamellæ of carbonate of lime, connected by an infinite number of siphonculi running right angles to them. Now suppose each lamella separated from that next to it, and the number of connecting siphonculi reduced to one between each lamina, and a polythalamous shell will be produced.

Still higher we find in the *loligo* a single cartilaginous plate, somewhat concave anteriorly, as though its edges were approximating to form a tube, enclosed within the mantle, and lying posterior to all the organs of respiration, circulation, digestion, &c. This cartilaginous plate performs the office, though imperfectly, of a vertebral column, forming an organ of protection for the nervous system. The carbonate of lime, so universal in the external skeletons of all the Mollusca, has here entirely disappeared, as though preparatory to the introduction of a new element characteristic of the skeletons of the higher classes, the phosphate of lime. By a very easy transition from this simple skeleton of the *loligo* we pass to the lowest of the cartilaginous fishes, where in the *petromyzon*, the vertebral column presents a form almost as rudimentory.

The respiratory and circulatory apparatus in the *loligo* are very nearly the same as in fish, being entirely aquatic; the aeration of the blood takes place in the branchiæ, placed on each side, hanging freely in the cavity of the mantle, and fixed on their dorsal aspect to cartilaginous laminæ, which may be considered the rudiments of branchial arches.

The blood brought by the venæ cavæ to two muscular cavities called auricles, and thence sent to the branchiæ, is returned to a third muscular heart, to which the name of ventricle has been given. There is here no essential difference from the circulatory organs in fishes, but a lower degree of development is indicated in the permanent disunion of the muscular hearts, a concentration of organs being one of the most characteristic features in perfection of development.

In the most simple of the cartilaginous fishes the vertebral articulations are not distinguishable; the spinal column is little more than a cartilage through which are dispersed granules of phosphate of lime, and even in osseous fishes the proportion of earthy matters contained in the skeleton is comparatively small.

The normal form of the vertebræ in fish is, a cylindrical body with two concave, cup-like articulating surfaces; the interval between two vertebræ being filled up by a fibro-cartilage, which of course presents two globular surfaces corresponding to the cavities of the vertebræ: this circumstance is of considerable importance, as we shall be able to show the steps by which a transition from this form, typical in fish, to the vertebra of a reptile has been effected.

The lateral development and extensive mobility of the intermaxillary bones are also worthy of observation, as the same characters obtain in the next class, the Batrachia.

In the *petromyzon*, the nervous system exists in a very rudimentary condition—very much in the state in which we observe it in the embryo of the chick; two delicate cords, placed along the back, and giving off from their sides other nervous filaments.

The two nervous cords developed in the embryo upon the serous layer of the germinal membrane diverge anteriorly to enclose three spaces, which being afterwards filled up by cineritious matter become the medulla oblongata, the optic lobes, and the hemispheres of the brain. In the class of fishes the optic lobes, dedicated to the supply of organs of sensation merely, are nearly double the size of the hemispheres; but as we ascend in the scale, the latter become gradually larger and extended backwards in proportion as the former are retarded in development, and also in some indefinable ratio to the power and extent of the intellectual faculties.

The organs of respiration in the class of fishes are always branchial, but present some differences in the two great divisions of the order, the cartilaginous and osseous fishes. In the latter the branchiæ, formed by innumerable ramifications of the branchial arteries, hang suspended from the branchial arches, having their outer edges free and movable. The water which is drawn into the mouth by the action of the os hyoides and branchial arches, passes over these vascular follicles, and escapes by an opening common to all the branchiæ of one side, and defended by a valvular structure composed of an opercular membrane and a bony operculum.

In the cartilaginous fishes, on the contrary, with the exception of two families, the sturgeons and the chimeras, the branchiæ, instead of having a free margin, are fixed, being connected with the integument by their external border. The consequence of this conformation is, that the water which passes over the branchiæ makes its exit through distinct canals opening on the surface, whose number varies from four to seven in different genera of the order.

In all this may be observed an evident tendency to a higher degree of development, an attempt on the part of nature to cause the respiratory apparatus of the most perfect of the class of fishes to assume the appearance of that possessed by the most inferior among reptiles, and the next step will be to inquire whether there is not to be found some intermediate state between the two.

The larva of the common frog is, during its larva condition, *bonâ fide*, a fish; its respiration is aquatic; its circulation double; it possesses four branchiæ on each side, suspended from branchial arches, not enclosed however by an operculum as in fish, but hanging free from each side of the neck. The heart consists of two cavities, an auricle and a ventricle; the whole of the blood passes through the branchiæ by four branchial arteries on each side; it is returned by as many branchial veins, which afterwards unite to form the abdominal aorta. This circulation is strictly branchial not systemic, and is in every respect the circulation of a fish. During this fish-like condition of the larva, the spinal cord presents no enlargements in its course, and extends down through a number of coccygeal vertebræ; at this period also the optic lobes are larger than the hemispheres of the cerebrum, as in fish.

This then may be considered to be the intermediate point of development between two series of forms of animal life, and here is the stage from whence to set out in marking the changes which are required to render, not only the same type, but the same individual capable of exercising its functions in a medium very different from that in which it originally existed.

After remaining in its icthyoid condition for an indefinite period of time, the duration of which is influenced by a variety of circumstances immediately affecting the development of the animal, as temperature, the action of light, the abundance or scarcity of food, &c. the tadpole begins to undergo certain changes, which are the prelude to a complete metamorphosis; changes which are to give it the organs and habitudes of a land animal, and enable it to act a part in a situation totally foreign to that to which it has been accustomed.

This first of this series of changes takes place in the nervous system. The direction of development, which has hitherto been longitudinal, becomes lateral; the spinal cord shrinks up, and the coccygeal vertebræ of the tail are gradually absorbed; enlargements of the cord are evident at the points where the organs of locomotion are to be produced, and shortly after these organs begin to display themselves.

At the same time an important change takes place in the relative magnitude of the hemispheres of the brain and the optic lobes. In fish, as before stated, the optic lobes are the larger, the hemispheres having attained but a very inferior degree of development; during the metamorphosis of the larva, the latter rapidly increase in size, till they have become considerably larger than the optic lobes; the olfactory tubercles are no longer separated from the hemispheres; the whole cerebral mass having assumed a more concentrated form, instead of presenting the appearance of a number of imperfectly united ganglia.

In speaking of the mode in which the blood circulates in the larva, I described four branchial arteries on each side, passing to as many respiratory organs, and conveying to them the blood which is to undergo the process of oxygenization.

Synchronously with the change which the nervous system undergoes, this mode of circulation experiences considerable and important alterations;—the anterior branchial arteries, which are so many subdivisions of the aorta, are obliterated—the posterior branchial artery alone remaining pervious; while its numerous ramifications are reduced to a single trunk, the union of which with the artery of the opposite side forms the trunk of the abdominal aorta. From the thoracic aorta is given off on each side a small pulmonary twig, which now becomes the channel through which the blood passes to the organs of aeration.

Another remarkable circumstance is the change which now takes place in the form of the vertebræ. The vertebra of a fish, we have said, presents two cup-like articular surfaces, the space intermediate between two vertebræ being filled up by elastic cartilage. The vertebræ of reptiles always present one convex and own concave articular surface, the globular head of one vertebræ fitting into the concavity of the one immediately below it, so as to form a ball and socket joint. While in the tadpole state, the vertebræ of the animal resemble those of fish; but it was observed by Dutrochet, that, at the period when the change in the respiratory apparatus was going on, the intervertebral substances became ossified, each uniting itself to the vertebra immediately preceding.

When the metamorphosis has been fully accomplished, the lungs of the adult animal are found to be tolerably perfect, but still not so minutely cellular, and consequently not presenting so extensive a surface for the aeration of the blood as in the higher reptiles. Nevertheless, the respiratory organ would appear to have made its appearance in so perfect a form rather suddenly on the stage, if we were not able to trace it progress towards perfection from fishes themselves through other members of the Batrachian tribe, up to the point where we have seen it completely formed, and capable of exercising all its functions in the adult frog. For this purpose we must return to our examination of the class of fishes.

All fish, with the exception of the genus *pleuronectes*, are furnished with an air-bladder, for the most part entirely isolated from any communication with the atmosphere, and inflated with an aeriform fluid, secreted sometimes by the internal walls of the airsac itself, sometimes by a distinct glandular organ attached to it. The air contained in this bag is found to vary with the habitude of the animal, the quantity of oxygen being increased in proportion to the depth of water which it inhabits.

This air-bag, which is totally imperforate in the least perfect osseous fishes, is found to communicate with the external atmosphere in the most perfect osseous, and in the cartilaginous, fishes; in the carp it opens by a long canal into the stomach, in the sun fish and in the sturgeon it communicates with the œsophagus.

In the *proteus anguinus* and the *siren lacertina*, animals belonging to that division of the Batrachia called *perennibranchia*, from the circumstances of their retaining their branchiæ and their aquatic mode of life during the whole term of their existence—we find two air sacs, very similar in appearance to the air-bladders of fishes, each communicating by a narrow membranous tube with the pharynx. Upon these sacs a minute branch sent off previously to the origin of the branchial arteries, is seen to ramify, but the influence which can be exerted on the circulation by this means is too slight to be taken into consideration.

Advancing one step higher in the scale, we come to animals which at a certain period of their life lose the organs of aquatic respiration, and breathe atmospheric air only by means of lungs—in short, undergo the metamorphosis we have been considering in the larva of the frog.

This change is first observed in the tritons or salamanders, belonging to that family of Batrachia which from the circumstances indicated has derived the epithet *caducibranchiæ*. In these animals the lungs still retain the form of simple sacs, in the upper and back part of which a cellular structure and more complex ramification of the pulmonary vassels begins to appear—a structure which is at length perfected in the family of the Crocodilida, where the most complete system of respiration obtains among reptiles.

It has now been shown, that in the two great systems which exercise the most important influence over the development of the animal, there is a gradual and well-marked progression towards perfection in the organs by aid of which these functions are performed ; and that it does not require the aid of the imagination to trace the steps by which the simple air-sac of the sturgeon has passed through the intervening stages in the proteus and the triton to the elementary lung of the frog and the more perfect organ of the crocodile.

It will be as easy to show that the same system of gradual progression has been followed throughout all the members of the series : the links which unite Batrachia with the Ophidian reptiles, and these latter with the Saurian tribes, are too evident to render necessary a lengthened detail.

In the genus *cæcilia* we are supplied with the form which connects the Batrachia with the serpent race. The auricle presents a partial septum, an indication of the change to be effected in the heart of the true serpents, where there are three distinct cavities. In the arrangement of the teeth upon the maxillary and palatine bones, the *cæcilia* resembles the proteus, but in the shape of the teeth comes nearer the true Ophidia.

With regard to the respiratory organs, the left lung is, as in serpents, retarded in development. The skin is soft and naked as in Batrachia, but according to Baron Cuvier, it contains, within its substance, small scales regularly disposed in transverse bands. The true serpents are separated from the Saurian reptiles by the total absence of any vestige of sternum or extremities ; this is the most prominent character, and will therefore be the most easily traced.

If we passed at once from Ophidia, where extremities are totally wanting, to the lizards where they are perfectly formed, we might suppose that there had been a sudden production in one order, of an organ, of which we had observed no elementary condition in the order immediately preceding ; a circumstance entirely at variance with all that has hitherto been observed.

But in this instance, as in every other, there have been successive stages through which the organs of locomotion have passed. There is a small family of reptiles placed between Sauria and Ophidia, in whom these organs are seen to be gradually developed. In the *anguis* and the *ophisaurus* a rudimentary sternum and pelvis are concealed beneath the integuments ; in the *scheltopusik* a small femur has been added, which here commences to display itself externally. From hence the gradual progress of the organ may be traced through the *chirotes*, the *bipes* and the *seps*.

In the same way may be seen the gradual increase in the size of the left lung which had been retarded in growth in Ophidia—and the progressive perfection of the organs of sense, of the osseous, and of the nervous systems. With regard to Chelonia, the highest in the class of cold-blooded vertebrata, the consideration of the numerous analogies which their anatomical structure shows to exist between them and warm-blooded animals, the commencement of a perfect division of the ventricle, and the evident transition from these animals to the class of birds, are subjects which would extend this paper beyond the limits of a brief memoir.

In the endeavour to trace the connection between these different tribes of animals, it is to be remembered that the materials for investigation are comparatively few; that unacquainted as we are with the internal structure, and more minute anatomical relations of the extinct races, we are deprived of the evidence most material to our cause; yet imperfect as our knowledge of these animals must necessarily be, we are able to trace in their analogies with existing genera, a type intermediate between two important divisions of the animal kingdom, and occupying permanently the station now held temporarily by Batrachia during their metamorphosis.

Examples of this kind, where the intermediate stages apparently wanting in our systems of zoology are to be discovered in the ancient strata of the earth, are very numerous. Among the fossil Echinodermata in the chalk formation, the gradation of development, from the flattened and ramified *euryale*, through the *clypeaster*, the *sentella*, the *ananchite*, the *galerite* and the *spatangus*, to the concentrated and spherical form of the *cidaris* and *echinus*, must strike the most cursory observer. The tertiary strata of the Paris basin, have furnished us with the links which were wanting in the order Pachydermata to fill up the hiatus which separated the pig and the tapir from the elephant.

If these observations be correct, no organ or system of organs, nor any new type in the animal world, can be said to have suddenly appeared on the stage of existence. There are certain laws to which nature herself is compelled to submit, and by which all her operations must be regulated; and notwithstanding the weight which attaches to the opinions of the learned professor already quoted, I cannot help believing that amongst them is to be found the law of progressive development.

III.—*Some Geological Remarks made in the country between Mirzapúr and Ságar, and from Ságar Northwards to the Jamna. By the Rev.* R. Everest, *F. G. S. &c.*

*Mirzapúr* is situated on a kankar bank on the southern side of the Ganges, and somewhat higher above the level of the water than these banks usually are. The steep side of it, towards the river, shows a section of strata similar to what is usually observed in this formation, viz. beds of clay and calcareous marl of different colours with nodules of limestone imbedded in them. The lowermost of these beds exhibit some inclination and faults in particular places, which indicate that they have suffered some disturbance since their deposition. Upon these the upper beds rest horizontally and unconformably. One or two casts of shells (apparently fresh-water) and some small fragments of vegetable stems, were the only remains I could observe. But the appearance of the kankar nodules here marks more strongly their origin than in any place I have yet seen. They are mostly of the form of stalactites, from the size of a finger to that of a wrist in thickness, and, when broken, shew a compact, splintery, bluish-grey limestone, with occasionally minute scales of silvery mica disseminated through it. Occasionally too they are dependent from the roofs of small cavities in the clay-beds, and at other times spread out into layers, so as to form a complete seam of limestone. Before quitting the subject of kankar, I wish to notice a remark I have sometimes heard made, that probably the formation of kankar is yet going on. Mr. Piddington alludes to this in his remarks on the silt deposited by the river Huglì, and from his analysis it would appear that the quantity of carbonate of lime in the silt is considerable. That kankar may be yet forming in many places where calcareous springs are now running, cannot admit of doubt; but that it is at present depositing from the waters of the Huglì or Ganges I am inclined to disbelieve. For, were this actually the case, we might expect to find kankar on low tracts that had been flooded, after the retiring of the annual inundations; whereas the very reverse of this happens. As far as my experience goes, kankar is never found on the low grounds that are inundated. On the contrary the kankar banks are the only parts of the country that remain several feet above the level of the highest floods*.

* Considerable deposits, however, of saline matter are to be found on lands overflowed by the Jumna, when the rains are over; which, of course, are a recent formation: but the saline deposits, as I have noticed elsewhere, are usually above the present level of the floods.

At the distance of four or five miles to the south of *Mirzapúr* we come to the sandstone range, about 200 feet high, and presenting a steep escarpment to the alluvial plain at its base. Thence it sweeps round in a N. W. direction to *Vindáchal,* where it may be traced nearly to the bank of the river. The front of it towards the water is covered with rounded boulders nearly to its summit. From hence this range extends to *Chunar,* as may be seen in Captain FRANKLIN's map, and east of that to a place called *Jemorah,* where I have before mentioned it as occurring. It preserves here the same character as at that place, viz. that of a small-grained, highly consolidated sandstone approaching to quartz rock, usually of a greenish grey or faint pink colour, and splitting into large slabs of divers thicknesses. At *Vindáchal* the general dip is to the west at an angle from 5° to 20°. Further to the east, where the road to *Ságar* ascends it at the pass of *Tárá,* the dip is to the west, and scarcely perceptible. At the *Tárá* waterfall a deep section may be seen of it. It presents no variety of character, nor is it at all interstratified with marls or shales. At the foot of the pass I found an efflorescence of soda on a kankar bank, similar to what occurs in the plain to the N. W. of *Ghází́pur.*

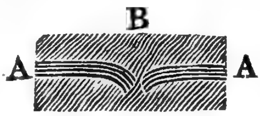
After ascending the pass we travel over a country nearly flat and covered with soil and vegetation. About 20 miles further on, at *Lálganj,* the rock was laid bare in the bed of a small nullah dipping slightly to the north. The soil above it contained pieces of kankar and iron ore, similar to what occurs about *Bankúra* and elsewhere. Nine miles further on in the bed of the Bálan river, the rock was exposed with a slight dip to the west. At the foot of the *Kattra* pass (for the situation of which I beg to refer to Capt. FRANKLIN's map, (Trans. Phys. Cl. vol. i.) I met with soda efflorescing, and kankar, at the side of a ravine, as I had done before at *Tárá.* From *Kattra* the road winds up a precipitous ascent over strata of sandstone dipping to the N. W. The sandstone does not appear to differ from that of the lower platform from *Kattra* to *Tárá,* but it is here interstratified with thick beds of red and greenish-grey marl-slate, and rarely with thin layers of a rock resembling greywacke, rather dark-coloured but containing pieces of slate imbedded. At *Mowganj,* two marches beyond *Kattra,* the dip of the rock was N. E. at an angle of from 10° to 15°, as seen in the bed of the nálá. At *Lour,* a little further on, they were quarrying a slaty marl, with shining facets and white streaks running through it. These streaks are calcareous and effervesce strongly with acids. Pieces of a compact splintery limestone are also to be found lying about on the surface. The strata here are horizontal. In the

*Pakaríga nálá,* between *Lour* and *Mangowa,* we first came to a thick slaty limestone, generally whitish, earthy, and marly, and varying to yellowish, greyish, and fine splintery. At *Mangowa* the dip was to the north, a red slaty marl. About this part of the country we begin to see a distant range of hills, bounding our prospect to the south and south-west,—the *Kymur* hills; judging from the outline, they appear to be sandstone with a horizontal stratification, and look as if a third platform or table-land existed in that direction. Beyond *Raypúr* a low hill appeared to the south of the road, of a thick slaty limestone similar to that at *Pakkáríga:* the dip very slight and irregular; layers of a black kind of porphyry are interstratified with it. This black rock sometimes changes suddenly to white, and appears vitrified exactly like porcelain. At *Rewah* the limestone was extensively laid bare in the bed of the river, but it is here principally massive, passing from greyish to bluish black and black, and exactly resembling the mountain limestone of England. At *Rámpúr,* one march beyond *Rewah,* strata of red and variegated marl, most of them calcareous, were exposed in the bed of the rivulet for two or three miles to the south;—dip slight to the north. Beyond *Rámpúr* the same bluish black limestone appeared as at *Rewah.* At *Patráhat* a similar limestone was resting on the variegated marl slates, with a slight dip to the north. Near *Loháwel* we passed over horizontal beds of a crumbling green and red marl for a considerable distance. At *Nágowar* a similar limestone appeared to that at *Patráhat,* resting like it upon the marl slate. But it here appears to abound in what I believe to be coralline remains, I might rather say, to be entirely composed of them. I forbear describing them, as I have sent specimens with this paper, which can be examined by those who have means of reference at hand*. I was not fortunate enough to discover any of the stems of ferns and gryphite shells, described by Capt. FRANKLIN; nor in my whole journey over this limestone did I meet with any other kind of organic remains than the one I have just now spoken of, though I made diligent search for them during a whole fortnight. They must, therefore, be extremely rare, and in this respect the limestone differs widely from any of the English limestones above the new red sandstone. From this place we passed alternately over strata of sandstone, red marl slate, and limestone, without being able to trace their connection with each other, until we came to *Hattah.* Here on the slope

* The specimens are deposited in the As. Soc. Museum: but their nature has not been ascertained. They are identical with what FRANKLIN named "stems of ferns." See As. Res. xviii. p. 29.—ED.

to the east of the village were horizontal strata of sandstone exposed to view; at the first nálá, lower down, was a whitish argillaceous limestone overlaid by sandstone; at a nálá still lower down, layers of sandstone, limestone, and red marl slate were to be seen interstratified. A few miles further on, at *Nagar,* a low cliff on the side of the river *Sonar* shewed a section of the strata as follows: uppermost layers, sandstone;—middle, red marl slate;—lowest (in bed of the river) argillaceous limestone. I had before conjectured that this would be the case from the continual alternations of sandstone and limestone, every mile or two along the road by which we had travelled, though both were horizontally stratified, and little or no difference of level was to be noticed. This led me to conclude that the limestone was of no great thickness, nothing more indeed than a bed in the sandstone, and the appearances I have now described at *Hattah* and *Nagar* confirm this. Capt. FRANKLIN speaks of the limestone being not more than 100 feet thick upon the sandstone, I have never found it 10 feet thick, without layers of sandstone interstratified. Beds of limestone of a similar kind do not appear to be uncommon in this formation: near *Cheynpúr,* about 35 miles to the south of *Gházipúr,* I had an opportunity of examining one of these. The sandstone range there presents nearly the same appearance as at the back of *Mirzapúr,* except that it is somewhat higher, and the dip, as far as I traced it, (which was about 20 miles to the eastward) is inwards, or to the south and south-west. At a place called *Mussaye* the limestone may be seen cropping out at the base of a sandstone hill, and dipping at a considerable angle to the south. It is usually slaty, but varies much in character in other respects, passing from grey to black, and then resembling the English mountain limestone. No remains could be found in it, but about 10 miles to the eastward it is seen again at *Bítrában d.* But I have neither seen, here nor elsewhere, any of the beds of loose slate and clay that accompany the lias in England. Were it necessary to class these with any of the European formations, transition limestone would be the most proper name for them. Though it is certainly more correct to consider them merely as beds in the sandstone; which sandstone, it must be remembered, is never found reposing on any but primitive rock.

As we leave *Patteria,* the easternmost extremity of the hills of trap fronts us, and the road winds along it for some distance. For 30 or 40 miles to the east of this the strata of sandstone had become broken and disturbed, dipping in various directions. Rolled pebbles of sandstone and pieces of agate and chalcedony are seen lying about, not confined to the water-courses and lowest grounds, but extending over the highest ridges. Near *Patteria*, the bank of the *Sonar* shewed a section of a bed of pebbles several feet thick, containing fragments of shells of the genera *cyclas*, *paludina*, and *unio*. At *Uslâma* I observed a curious appearance, which would lead to the inference that kankar nodules and the soil in which they are imbedded were deposited on the sandstone at a time when the latter was in a state very different from what it is at present, viz. soft and flexible. At first sight it appeared that the kunkar and soil were interstratified with the upper layers of sandstone; but on looking further it seemed that both had come in from above through a fissure in the rock, and that the layers at the edge of this fissure had been bent downwards, as if by the superincumbent weight. Thus




A, layers of sandstone.
B, kankar and soil.

Now no pressure however applied is sufficient to bend a layer of sandstone in its present state. In the ruined palace of Akbar at *Fattehpúr Sikri*, many slabs of sandstone that have formed parts of the roof of the building may be seen broken asunder from long-continued pressure, but none of them, though there are many entire, are in the slightest degree bent.

At a short distance beyond *Patteria* the road passes over a white earthy limestone rock, containing sandstone gravel imbedded. This, in some places, loses all massive appearances, and becomes a collection of nodules not differing from kankar. They are however more white and earthy, approaching to the nature of chalk, than I have met with in the country to the eastward. As we advance, the peculiar outlines of basalt present themselves in the country round. The road soon crosses what has apparently been a stream or *coulée*, and has taken the lowest ground. It is dark-coloured, nearly black, and considerably cellular on the outside; yet this is an effect only produced by weathering; within, it is a solid hard basalt, of great specific gravity, and containing olivine imbedded. The surface of the soil in the country round is strewed with large round balls, resembling the volcanic bombs of volcanic districts: but they too, although scoriaceous on the outside, are, within, a solid basalt. With these are found abundance of agate and chalcedony. These appearances continue all the way to *Ságar*, and the rock does not differ in character, except that it sometimes becomes of a lighter colour, and is then in a high state of decomposition, crumbling under the hand. Three or four miles before reaching *Ságar*, where the road had been cut through the rock, a ridge of basalt affecting the columnar form is seen resting upon a lighter coloured stratum, which shews by its state of decomposition, its great antiquity. From all I have been able to see or learn of this formation from others, it appears every where to preserve great uniformity of character, and resembles (as stated by Mr. Lyell when speaking of it on the banks of the *Nerbudda*) the currents of prismatic lava in Auvergne. Currents of porous lava, cones of cinders, scoria, pumice, ashes, all those products that peculiarly belong to modern volcanic formations, are wanting. We meet every where with a compact heavy basalt, with olivine sometimes and augite crystals imbedded, and agates, chalcedony, and jasper in great variety and abundance. And though some of the currents appear to have taken the lowest ground, yet their outlines are so worn down and effaced, and their surfaces are so deep in soil and vegetation, that it is difficult to assert even this with certainty.

About a mile distant from *Sâgar* many white blocks appeared by the road side, which I at first mistook for a kind of trachyte, from the peculiar rugged appearance of them : add to this, that crystals are disseminated in the porous earthy base, looking just like the crystals of glossy felspar in that mineral. On minuter inspection, however, it is nothing but limestone. Its softness, its strong effervescence in acid, and specific gravity, (2.67) separate it from every substance with which it might be confounded. Besides the form I have mentioned, it sometimes becomes altogether earthy, and then reminds us of the most common form of deposits from calcareous springs : at other times it is altogether crystalline, and then passes into a fibrous form, resembling satin-spar, or calcareous alabaster. It has been deposited at the side of a *couleé* of basalt, and it is here that Capt. Sleeman discovered the remains of palm trees changed to a brown-coloured flint, or rather jasper. As one kind of palm tree (the date palm, I believe) yet commonly grows by the side of most running streams in this part of the country, we have no reason to suppose any change of climate to account for their appearance here. The manner, however, in which they are scattered through the soil is not so easily explained. They are usually found above the solid stratum of calc-tuff, and a trunk is seldom found entire ; but they are in sharp angular* fragments, as if they had been shattered by a violent blow : with them are pieces of the calc-tuff, which is found below. In the short distance from *Patteria* to *Sâgar* we had met with two of these for-

* Nor do we find traces of any such substances disseminated through the tufaceous limestones, as is commonly the case in volcanic tuff.

mations*. They are nothing but kankar somewhat more developed, and probably were deposited at a period when the continent was raised above the level of the surrounding ocean. Among the remains, however, from the neighbourhood of *Jabalpur*, which appear also to have come from a recent calcareous deposit, are shells which appear to be marine. At *Tuismahl*, about 30 miles north-east from *Ságar*, I had an opportunity of observing another mineral more largely developed than I had seen it in the country to the eastward. This is the hydrated iron ore, which occurs in loose pieces about *Bardwán* and *Bankúra*, often accompanied by kankar. It is, I believe, the laterite of Dr. BUCHANAN, and here forms the summit of the *Tuismahl* hill in a bed of many feet in thickness. For the reason why a deposit from springs can thus cap an isolated hill rising out of a plain, I must refer to M. MONTLOSIER's ingenious explanation of the isolated peaks and platforms of basalt in Auvergne. This mineral is largely developed in the country to the north of *Tuismahl*, and is, I believe, the ore which is usually smelted for iron.

We left *Tuismahl* in a N. W. direction, and soon came upon the sandstone again. It is, to be sure, occasionally to be seen in isolated ridges rising out of the basalt; but now this latter disappears, and it becomes the formation of the whole country round us. We find the basalt again some miles before reaching *Isságarh*, a fortress about 50 miles north of *Seronj*, and it here shews more symptoms of a recent formation than I have yet seen. The *couleés* are better defined; they have evidently, in some places, taken the lowest ground, and their surface is yet rugged in a degree, but their composition is, as before, a solid basalt. We quit the basalt altogether at *Isságarh*, and come upon the sandstone, which we travel upon to *Pahárgarh*, about 30 miles west of *Gwalior*, where we descend into the plain, and find ourselves again among kankar banks and ravines. The sandstone remains unaltered in character. In the bed of the Betwa it was quartz rock. In the country round *Delhi* it is usually quartz rock, nearly perpendicular, and dipping to the eastward. A few miles to the south of *Pahargarh* I observed a peculiar appearance of the kankar. It forms a calcareous cement to a bed of rounded pebbles, and above this forms another bed similar to those which are to be seen so frequently on the banks of the Ganges.

* There is no known force but that of an earthquake that could produce such effects. From Dr. SPILSBURY's account of the fossil shells he found near *Jabalpúr*, they appear to be scattered through the soil in a similar manner.

## IV.—*On the Native Alum or Salájít of Nepal. By* A. Campbell, *Assistant Surgeon, &c.*

In the number of the Asiatic Society's Journal for June last, there is a notice and analysis of one of the mineral productions of *Nepal* called "Salájít," or, by the natives of this place more commonly "*Pathar ka Passeo*" or simply "*Passeo*" (Sweat). As the analysis was furnished by Mr. Stevenson with the object of bringing the substance to public notice towards its extensive employment in the arts, the following particulars regarding it may I hope contribute in some degree to facilitate the above purpose. The specimen analyzed by Mr. S. contained in 100 parts, 95 parts of sulphate of alumina, but it is not generally speaking procurable in that state of purity; the following, the result of examination by Captain Robinson of several portions taken at random from the bazar, shews more correctly the value of the mineral as it is obtainable in large quantity, and in the state in which alone it could be made available for use in the arts. The purer portions being in such demand in medicine and surgery, are raised in price to an extent quite incompatible with their profitable application to the general uses of commerce. In 100 grains are contained, sulphate of alumina, 66.

The mineral in the above state (often more pure) is found throughout the lower, central, and upper hills of *Nepal.* Its external characters are those described by Mr. S.* save that the lumps have generally an admixture of red sand, and frequently portions of micaceous stone embedded in them; some of the lumps have the smooth surface of stalactites, and are not unlike these deposits. All are readily soluble in water, and when touched with the tongue give the taste of common alum. It is said to exude in this state from the surface of soft rocks; and sometimes to be dug out of their substance; and from these sources it is collected in considerable quantities during the cold and dry seasons, and carried by the Bhoteahs, Múrmis, and other hill people to *Katmandú,* to be exchanged with the merchants of that city for money or other articles. From hence it is distributed thoughout the valley in small portions for medical purposes, while the bulk of it is carried to the plains of India by petty Newâr merchants, and the numerous Baiparís who annually visit this country from various adjacent, and remote parts of Hindústan. The cost of production and transport of an article to the scene of its consumption, is the first knowledge the trader wants; and if the price paid by Mr. S. for his specimen (one rupee for two rupees' weight) was the real value of Salájít on the banks of the Ganges, its use in the arts

* In small light lumps, colour brownish white; externally anhydrous; internally semi-crystalline; fracture slightly fibrous, with a lustre resembling asbestus; porous, containing small cavities lined with scarcely perceptible needle-like crystals; adheres a little to the tongue. Taste acidulous saline, soluble in twice its weight of distilled water; specific gravity not ascertained, but probably not quite double the weight of distilled water; friable.

of dyeing, printing, &c. at that place, as at any other further removed, must for ever remain problematical. The price he paid for it was that which the physicians of India give for a drug to which they attach an undue merit, and on the sale of which they realize a huge profit from their credulous and ignorant patients. A respectable authority tells me that he has paid for this stuff at Benares one rupee for one rupee weight, and at more remote places from *Nepal* it is sold at a rate still more exorbitant. The average price of white* *Salájít* in *Katmandú* ranges from 12 annas to one rupee a *dharné* of three cacha seer, or from 11 to 15 rupees per pakka maund of 40 seers, and the cost of transport to the banks of the Ganges or Gandack is as follows:—

A hill porter will carry two maunds from hence to *Hitounda* for two rupees one anna, and a bullock will carry from thence to *Patna* four maunds at a charge of two rupees seven annas, or from the same place to *Govindganj* (on the *Gandak*, 10 miles south of *Bettiah*) for one rupee 14 annas. Thus the mineral can be stored at *Patna* at an average cost of from 14 8 to 18 8 rupees per maund, and at *Govindganj* for 15 annas per maund less, i. e. for 13 9 to 17 9 rupees. This calculation except the carriage from *Hitounda* is made in Nepalese rupees, the difference between which and sicca rupees is as 128 of the former to 100 of the latter, and there is no additional expense except an export duty of $2\frac{1}{2}$ per cent. *ad valorem*, levied by the *Nepal* government, unless there be (unknown to me) an import duty levied in our provinces, on minerals the product of this state.

The quantity now annually exported from *Katmandú*, as far as I can ascertain, is not more than 15 or 20 maunds, but I believe that there would be no difficulty in procuring any quantity required of it, and that without any addition to the present cost; for as it is found without the previous expense of digging mines, and transported without the necessity of making roads, an increased demand would only have the effect of inducing a greater number of the hill people to collect the stuff in the hills of their neighbourhood, and convey it to the capital; or perhaps with a steady demand the produce of the lower hills would be carried direct to the plains by the collectors of it, and the profit of the first buyer or *Katmandú* merchants by this means saved to the consumers in the plains. *Salájít* in Nepal as well as in India is at present confined exclusively to use in medicine and surgery, and in both countries it enjoys a very high reputation, and is used in both as a remedy in the same diseases.

In India it is in much greater repute than in the land of its production, as its price there shews; and its virtues in some affections are

* There is a dark bituminous substance used in *Nepal*, said to be exuded from rocks; it is called " Black Salájít." I am ignorant of its nature; it resembles in external character the bituminous alum ore (called shale) which is said to be found in Sweden and in many coal mines in England, but there is much vegetable matter in it, and it is probably a vegetable production, notwithstanding the belief by the *Nepal* physicians of its mineral nature.

said to be unequalled. Internally it is given as a sovereign remedy in *parméo* (gonorrhœa), in gleet, gravel, stone in the bladder, seminal weakness, and sometimes in alvine fluxes; its dose is (to an adult) 10 grains finely powdered and given in ghee: it also composes an ingredient in several of the compound medicines administered by the native physicians, and is said (possibly with justice) to be an admirable remedy in gravel as well as in diarrhœa. Externally it is chiefly employed in powder as a styptic in recent wounds, and, in solution, to bruises and sprains, as well as a wash for foul ulcers. In severe cases of falls and bruises it is internally administered, apparently without any better reason than the one stated by themselves, viz. that its being good for a bruised leg "ought to make it useful to the internals of a hurt man." It is much prized by old women as a remedy in infantile diseases, such as slight fever, diarrhœa and bronchitis—and few faqírs who dispense health to the body are without this mineral. It is exported, from *Nepal* in small quantities to almost every part of India, as few traders, from the horse merchant of the *Panjáb* to the Baipárí of *Tirhoot,* leave this without some of the drug, and the faqírs, who flock here annually in incredible numbers, distribute their small stores to their brethren of the craft at every pilgrimage from *Jagarnáth* to *Mánsurwar*, and from *Rámeswar* to *Dwaríka.* This mineral is not confined to *Nepal;* it is a produce of some part of Behár*, and is said to be found in small quantity in different parts of the Vindhya range of hills; although according to the testimony of the *Katmandú* merchants "of inferior value in medicine to that of *Nepal.*" Its use in the arts of calico printing, dyeing, &c. does not seem to have been contemplated even in India, where those arts have been so long practised; and although printing is done after a rude fashion throughout the valley of *Nepal,* and the mineral is a native of its surrounding hills, I cannot learn that it is ever used in the making of mordants, for which purpose the sulphate of alumina is above all other salts the best adapted, and for which it is in such large demand throughout Europe. It remains therefore for European intelligence to introduce this mineral into general use, and when it is considered that all the alum used in Europe for dyeing, printing, whitening paper, tanning and dressing leather, &c. &c. is manufactured by a tedious and expensive process, it will seem strange that a nearly pure native sulphate of alumina should be so abundant within a few days' journey of the river Ganges, and not have long ago, attracted the attention of the mercantile community of India, or the numberless dyers, printers, and tanners carrying on their separate vocations throughout the Gangetic valley. To assist Mr. STEVENSON or any other person in procuring this substance, I offer such aid as being on the spot will enable me to give.

* Dr. HAMILTON in his account of *Nepal* says, "I have collected Salájít in Behar with my own hands."

## V.—*Defence of Lt. Burt's Trisection Instrument.*

To the Editor of the Journal of the Asiatic Society.

Sir,

The accompanying observations regarding the correctness of Mr. Burt's instrument for trisecting angles, described in No. 11, suggested themselves to me, in consequence of my attention having been drawn to it by some remarks contained in a note at page 159 of No. 15, and I take the liberty of sending them to you, in the hope, that should you think them likely to be of interest to any of your readers, you will give them a place in the Journal of the Asiatic Society. As it is not improbable, however, that ere this letter reach you the subject may have been taken up by a more able correspondent, or that its object may have been anticipated by Mr. Burt himself having forwarded a reply in defence of his invention, I hope that in either of these cases you will have no hesitation whatever in laying this communication aside.

In the note above alluded to, it is objected to Mr. Burt's demonstration of the correctness of his instrument, that the rad. *b o* is not proved equal to rad. *a o*, and that it is in consequence imperfect. In the way however in which I understood the description, it appeared to me that the length of *o b* was *constant*, the leg *a d* being confined to a fixed point of it by a groove; and although not so expressed, I imagine it must have been intended that, that point should be at an equal distance from the centre with the point *a*. Should this supposition be correct, the demonstration would, I imagine, be complete, without the necessity of proving that the locus of the point *b* is the circumference of the circle; but that such is the case whenever the angle is trisected, would be easily demonstrated as follows:—Let BAF (*fig.* 1) be any angle whereof BF is the chord, and let AC be the line trisecting the angle BAF and crossing the chord BF in D. It is required to prove that if from the point B with the radius BD an arc be described cutting AC in C (whence BC=BD) then, that the point C shall be situated in the circumference of the circle whose centre is at A and radius=AB, or that AC will equal AB.

First $\angle$ BDA $=$ $\angle$ DAF $+$ $\angle$ AFD (*El.* I. 32)
$=$ $\angle$ DAF $+$ $\angle$ ABD (*Hyps.*) (No. 1.)
Again $\angle$ BDA $=$ $\angle$ DBC $+$ $\angle$ BCD
$=$ $\angle$ DBC $+$ $\angle$ BDC
$=$ $\angle$ DBC $+$ $\angle$ DAB $+$ $\angle$ ABD
Equating these two values of $\angle$ BDA, we have
$\angle$ DAF $+$ $\angle$ ABD $=$ $\angle$ DBC $+$ $\angle$ DAB $+$ $\angle$ ABD
Taking $\angle$ ABD from each side, $\angle$ DAF $=$ $\angle$ DBC $+$ $\angle$ DAB
But $\angle$ DAB $= \frac{1}{3}$ $\angle$ DAF (by hyp.) therefore $\angle$ DBC also $= \frac{1}{3}$ $\angle$ DAF
Whence also $\angle$ DAB $=$ $\angle$ DBC
But the angle ADF or its equal $\angle$ BDC, or $\angle$ BCA
$=$ $\angle$ DAB $+$ $\angle$ ABD or
$=$ $\angle$ DBC $+$ $\angle$ ABD or
$=$ $\angle$ ABC
Whence AB $=$ AC.

With regard to the latter part of Mr. B.'s paper, concerning the removal of the fourth leg of the instrument, I am not quite sure that I fully comprehend the mode in which the construction of the scale is detailed. If, however, the following be a correct explanation of the meaning, there can, I imagine, be no hesitation in admitting the conclusion he has drawn. In forming the scale of equal parts upon this fourth leg AB (*fig.* 2) each point in the scale is to be successively brought to the circumference by turning the scale round the point A, so as that each division shall in turn terminate a chord of the variable arc AG, and the *line marking the division* is then to be cut on it, in the direction of the radius passing through it. At the same time the leg AD being placed in its corresponding position (viz. at an equal distance on the other side of a perpendicular to CG), its divisions will be marked by the *same* radius, and this is to be done for every point of the circumference A$G g$B'.

The divisions upon AD, therefore, form a scale of chords equal in length to those of the corresponding arcs AG, A$g$, and each of the lines forming them, will by the construction tend to the centre when AD is so situated as to cut off an arc three times the extent of that of which AG is the chord; and the application of the instrument merely consists in adjusting the line AD to the chord of the given arc, and then turning round the movable radius CG till it coincide with the division, which in that position would if produced pass through the centre, and which, if the coincidence be exact, will of course direct the radius to an arc one-third of AD. It must however be shown that in any position of AD there can be *only one* of the divisions which tends to the centre (or can be made to coincide with the radius), this may be easily proved; for if FL (*fig.* 2) be the correct division on the scale, cutting off (by radius passing through it) the arc AG = one-third of the arc AD, and if $f\,l$ be any other division belonging to an arc A $g$ the whole of the divisions having been marked off in the manner above described, then it may be demonstrated that the radius C$f$ will, if drawn through $f$, form with $f\,l$ an angle $l\,f\,n$ equal to the angle $f$C F plus half the angle $g$CF*. The instrument therefore seems to be complete enough in theory without the fourth leg, but in use, it appears to me that the want of it would considerably diminish its accuracy, as it must be very difficult to hit upon the exact coincidence when the divisions are very numerous, and as any error at the point F would be multiplied at G in the proportion of the two distances CF : CG, this would be a serious evil in large angles, as the focus of the point F is a curve which

* The demonstration of this is as follows, vide fig. 2.

$$\begin{aligned}
\text{First } \angle\ CGA &= \angle\ GCM + \angle\ CMG \\
&= \angle\ GCM + \angle\ CgA - \angle\ gAM \\
&= \angle\ GCM + \angle\ CgA - \tfrac{1}{2}\angle\ GCM\ (\textit{El.}\ \text{III. } 20.) \\
&= \angle\ CgA + \angle\ \tfrac{1}{2}\,GCM
\end{aligned}$$

$$\left.\begin{array}{l}\text{But } \angle\ CGA = \angle\ AFL \\ \text{And } \angle\ CgA = \angle\ AFL\end{array}\right\}\ \text{(by hypothesis)}$$

Therefore substituting these values in above equation

$$\angle\ AFL = \angle\ Afl + \tfrac{1}{2}\angle\ GCM\ \text{(No. I.)}$$

$$\text{Again } \angle\ CfD \text{ or } Afn = \angle\ CFf + \angle\ fCF$$

$$\text{Or } \angle\ AFl + \angle\ nfl = \angle\ AFL + \angle\ fCF$$

Or, by substituting the value of $\angle$ AFL found at (No I.)

$$= \angle\ Afl + \angle\ fCF + \tfrac{1}{2}\angle\ GCM$$

And subtracting $\angle$ A$fl$ from each side of the equation

$$\angle\ nfl = \angle\ fCF + \tfrac{1}{2}\angle\ GCM$$

Q.E.D.

gradually approaches, and ultimately (when the angle trisected equals 180°) passes through the centre.

Mr. B. says that the fourth leg is absolutely necessary to the first construction of the instrument, but it has occurred to me that by forming the scale upon AD in a different manner it might be dispensed with altogether. For since AG is always equal to AF, and consequently the angles AFG and AGF also equal, it follows that if the arm AB be turned round till AG coincides with AF, that the point G will also coincide with the point F, and the line FL would form an angle with AG ; as for instance the angle A$Gp$ equal to the angle AFL or AGF. The instrument would therefore I think be equally correct if the divisions upon AB were first drawn in the way that Mr. B proposes, as above described, and, if this leg when complete were afterwards converted into the chord AD by *reversing* the inclinations of all the lines $Gq$, making them form equal angles on the opposite side of a perpendicular to AB, for then $\angle p$GA would be equal $\angle$ B$Gq = \angle$ FGA $= \angle$ AFG.

As I before observed, the locus of the point F (*fig.* 2) is a curve passing through the centre C. A representation of this is given in fig. 3, which also shows it continued, and passing through the extremity of a diameter at right angles to GC, which it again meets at M, GM being equal to GL, the diameter of the circle GDL. From the circumstances of the distance DK being always equal to 2 vers-sin. $\angle$ DCG (which may be easily deduced from Mr. Burt's theorem) may be derived an equation to the curve when the co-ordinates originate at the centre ($r$ being $=$GC)

$$y^2 = 2rx - x^2 + \frac{r^2}{2} - r\sqrt{2rx + \frac{r^2}{4}} \; *.$$

As it is also easily described geometrically, it affords a very simple form for the construction of an instrument for trisecting any angle from 0 to 180°, and consisting of a *single* piece only. A representation of one which I have lately made up, and found to answer my expectations fully, is given in fig. 4. It consists simply of an ivory scale, whose edge is sloped off, and accurately formed to the figure of the curve GKC (*fig.* 3), and a small part of the diameter GL produced on each side to ensure its accurate adjustment to one of the sides containing the given angle, for which purpose also small portions of the edge at C and G are cut away, in order that the coincidence of these two points with the centre and point G of the chord of the given angle may be accurately determined. As no graduation whatever is necessary the instrument is very easily made, and the application of it, which is also extremely simple, will be understood from the following example : I must first mention, however, that for more convenient measurement the exact length of the radius GC is laid off on the centre of the scale between the points M and N.

Let GCD (*fig.* 4) be any angle to be trisected.

From the point C with the distance CG or MN as a radius, describe an arc GLD. Draw the chord GD, then apply the scale so as to make its edge coincide with the side CG of the given angle, and the point C with the centre of the circle

* From this equation may be derived the other properties of the curve just mentioned. For instance if $x$ be taken equal to $o$, then $y$ becomes $= o$ or $r =$ CH. If $x = r$, then $y$ also becomes $= o$ or $r\sqrt{3} =$ GF ; and lastly, if $x$ be taken equal to $3\,r$, then $y$ becomes $= o$ or an imaginary quantity. The curve will therefore pass through the points G,C,H and M.

GLD, and of course since the radius is by construction equal to GC, the point G will coincide with the point G (of the chord). Make a mark at the intersection of the curve GKC with the chord GD, and a line drawn from the centre through that point (K) will trisect the given angle. As the curve GKC is the locus of the point D in fig. 1, when DB is equal to BC and AB=AC, which corresponds with the conditions of Mr. BURT's demonstration, it is unnecessary for me to trouble you with any proof of the correctness of the instrument in addition to that already given by him. By extending the principle and making use of different curves† and with some necessary modifications, an instrument might be constructed, in a *single piece*, to divide any given angle in *any* given ratio (within moderate limits), but as I have no hopes that any contrivance for this purpose, however simple in application, or comprehensive in its powers, will ever supersede the good old method by trials with the compasses, I shall not further trespass on your patience by indulging in any useless speculations on the subject.

I am, Sir,

Your obedient servant,

J. S.

*Masulipatam,*
*3rd July,* 1833.

P. S. I imagine Mr. BURT's parallel lines passing through the same point are intended to be referred to different places, being coincident, and passing through the centre when referred to the plane of the instrument, but parallel when referred to one perpendicular to it.

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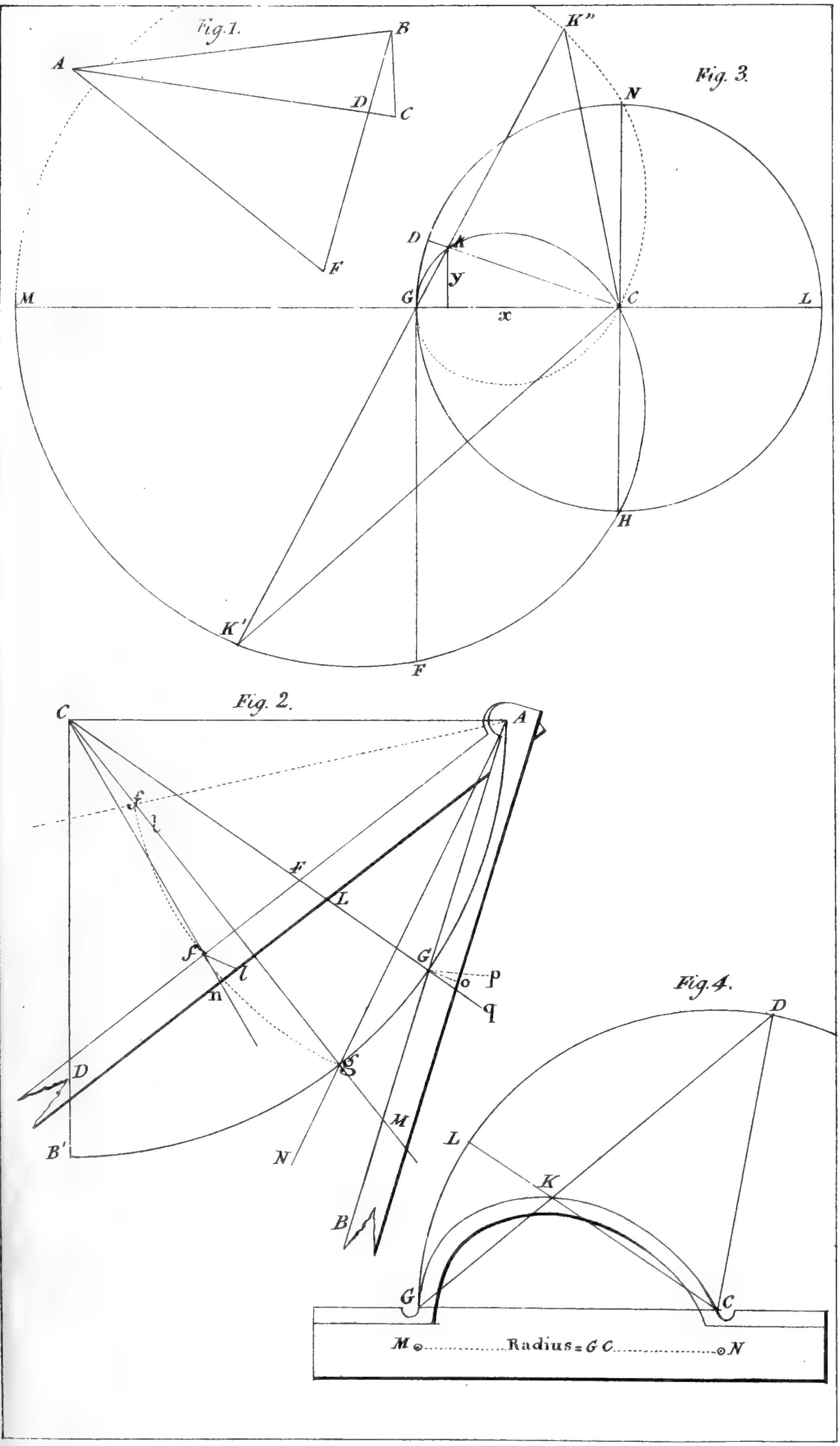
## VI.—*Computation of the Area of the Kingdoms and Principalities of India.*

Captain J. SUTHERLAND, late Private Secretary to the Vice-President, having been recently engaged in the preparation of a note on the political relations of the British Government in India, adopted a mode, on the recommendation of the Surveyor General, of obtaining in a rough way the area, or contents in square miles, of each state, without the labour of elaborate calculation, to which the imperfect data of our maps of the country could not ensure very great accuracy.

The boundaries of each state having been marked off on a skeleton map drawn on paper, of equable texture, as accurately as this could be done from information procurable in the Surveyor General's Office and the Political Department, the whole were cut out with the greatest care, and weighed individually, and collectively as a check, in the most delicate balance of the Calcutta Assay Office. The weights were noted to the thousandth part of a grain, the balance being sensible to the tenth part of that minute quantity. Fifteen precisely equal squares of paper (unfortunately

* If the *whole* curve be used and the chord produced each way, it will intersect it in three points (as shown at KK'K" *fig.* 3), giving as many positions of the line CK, and as many solutions of the problem. In this case the intersection with the interior loop, as at K, marks the third of the given angle, while those with the exterior branches of the curve trisect its complement (or if larger, its excess beyond 90°) and supplement.

† The locus of the point of bisection for instance would be a semicircle on the diameter GC.




J. B. Tassin lith.

not the same as that used for the map) were previously weighed to ascertain the extent of variation to which such a mode of measurement would be liable: the results were not very favorable, neither was the paper of such equal texture as might be fairly compared with that used for the map: the weights were as follows—(to the nearest hundredth of a grain,) apparently increasing towards the edges of the sheet.

| | | |
|---|---|---|
| 1 = 2.65 grains, | 6 = 2.95 grains, | 11 = 3.05 grains. |
| 2 = 2.65 | 7 = 2.90 | 12 = 2.75 |
| 3 = 2.65 | 8 = 2.90 | 13 = 2.65 |
| 4 = 2.68 | 9 = 2.80 | 14 = 2.65 |
| 5 = 2.80 | 10 = 3.10 | 15 = 2.75 |

Before setting to work on the states, an index or unit of 100 square degrees, cut from the same paper, was first weighed to serve as a divisor for the rest.

The weighing process commenced in the driest part of the day, taking the whole of the papers together; thus the continent of India weighed 127.667 grains troy. The sum of the individual weights of the separate states was 127.773. The addition was proved to proceed from the hygrometric water absorbed towards the evening; thus ~~weighed,~~ the British states weighed at first 74.366, at the conclusion 74.445; the native powers, at first 53.301; the sum of them weighed individually was 53.407; afterwards, weighed in groups 53,456, being later in the evening. In drawing out the table for calculation, proper corrections were applied to neutralize this source of error, but coupled with the previous examination of the texture of paper, it is sufficient to shew that the following table must be looked upon only as a rough approximation in the absence of better information. The superficial area of Hindustan, exclusive of the independent states of Nipal, Lahore, &c. according to Hamilton, between the latitudes of 8° and 35° north, and the longitude of 68° and 92° east, cannot be estimated at more than 1,280,000 English square miles: and the portion belonging to the British and their allies, at 1,103,000: this estimate agrees very well with the present statement.

| | Square miles. |
|---|---|
| The area of the native states in alliance with the British Government was found to be,.................................................... | 449,845 |
| That of the territory under British rule with the remaining small states and jágírdars, ................................................ | 626,746 |
| Superficial area of all India,........................................ | 1,076,591 |

The extent of coast from Cape Negrais to the frontiers of Sinde is 3622 British miles, the breadth from Surat to Silhet, 1260 miles.

Captain Sutherland classifies the native states of India under the three following heads:

I.—*Foreign*, viz. Persia, Kabul, Senna, the Arab tribes, Siam, Acheen.

II.—*External, on the frontier;* viz. Ava, Nepal, Lahore, Sinde.

III.—*Internal*, which are those included in the present list. All of these have relinquished political relations with one another and with all other states. They are, according to the nature of their relations or treaties with the English, divided into six classes:

First Class. *Treaties offensive and defensive: right on their part to claim protection, external and internal, from the British Government: right on its part to interfere in their internal affairs.*

| | | Square miles. | | Square miles. |
|---|---|---|---|---|
| 1. | Oude, containing, by weighment,.... | 23,923 | by Hamilton*, | 20,000 |
| 2. | Mysore, ........................ | 27,999 | ............ | 27,000 |
| 3. | Berar or Nagpúr,.................. | 56,723 | ............ | 70,000 |
| 4. | Travancore, ...................... | 4,574 | ............ | 6,000 |
| 5. | Cochin,......................... | 1,988 | ............ | 2,000 |

Second Class. *Treaties offensive and defensive: right on their part to claim protection, external and internal, from the British Government, and to the aid of its troops to realize their just claims from their own subjects: no right on its part to interfere in their internal affairs.*

| | | Square miles. | | Square miles. |
|---|---|---|---|---|
| 6. | Hyderabad, containing, by weighment, | 88,884 | by Hamilton, | 96,000 |
| 7. | Baroda,......................... | 24,950 | .............. | 12,000 |

Third Class. *Treaties offensive and defensive, states mostly tributary, acknowledging the supremacy of, and promising subordinate co-operation to, the British Government; but supreme rulers in their own domains.*

8. Indore, containing,................ 4,245 square miles.

| *Rajputána States.* | | Square miles. | | | Square miles. |
|---|---|---|---|---|---|
| 9. | Oudípúr, (H. 7,300,) | 11,784 | 16. | Jesalmír, ...... .. | 9,779 |
| 10. | Jeypúr, .......... | 13,427 | 17. | Kishengurh, .... | 724 |
| 11. | Joudpúr,.. ....... | 34,132 | 18. | Banswára, ...... | 1,440 |
| 12. | Kotah, (H. 6,500,) | 4,389 | 19. | Pertábgurh, .. .. | 1,457 |
| 13. | Búndí, (H. 2,500,) | 2,291 | 20. | Dúngarpúr, .. .. | 2,005 |
| 14. | Alwar,............ | 3,235 | 21. | Kerolí, ........ | 1,878 |
| 15. | Bikhanír,........ | 18,060 | 22. | Serowí, ........ | 3,024 |

| | | | Square miles. |
|---|---|---|---|
| | 23. | Bhurtpúr, (by Hamilton, 5,000,)............ | 1,946 |
| | 24. | Bhopal, (ditto 5,000,)...................... | 6,772 |
| | 25. | Kutch, (H. with the Runn 13,300,)............ | 7,396 |
| | 26. | Dhár and Dewas, ......................... | 1,466 |
| | 27. | Dhólpúr, ................................ | 1,626 |
| *Boghelkhand,* and *Bundelkhand,* | 28. | Rewah, .................................. | 10,310 |
| | 29. | Dhattea, Jhánsí, Terhí, ...................... | 16,173 |
| | 30. | Sawantwarí, ............................ | 935 |

Fourth Class. *Guarantee and protection, subordinate co-operation, but supremacy in their own territory.*

31. Ameer Khan, { Tonk,...... 1,103; Seronj, .... 261; Nìmbahara, 269 } .... 1,633 square miles.

32. { Patiala, Keytal, Naba and Jeend, } ..................... 16,602

Fifth Class. *Amity and friendship.*

33. Gwalior, containing,..................... 32,944 square miles.

Sixth Class. *Protection, with right on the part of the British Government to control internal affairs.*

34. Sattara, containing, ..................... 7,943 square miles.

35. Kolapúr,............................. 3,184

* This column, and other items marked H., extracted from Hamilton's Hindustan by way of comparison.

Of the above states, four are Mohammedan; viz. Hyderabad, Oude, Bhopal, and Tonk. Of the Hindu states, eight are Marhatta; viz. Sattara, Gwalior, Nagpúr, Indore, Banda, Kolapúr, Dhar, and Dewas.

Nineteen are Rajput; viz. Oudípúr, Jeypúr, Joudpúr, Búndí, Kotah, Kutch, Alwar, Bhikanír, Jesalmír, Kishengarh, Bánswára, Pertábgarh, Dúngerpúr, Kerolí, Serowí, Rewah, Dhattea, Jhansí, Terhí.

Six are of other Hindu tribes; viz. Mysore, Bhartpúr, Travancore, Sáwantwárí, Cochin, and Dholpúr.

Besides these allied states, there are the following inferior Rajships and Jágírdarís: viz. Chota Nagpúr, Sirgújer, Sambhalpúr, Singhbhum, Oudípúr, Manipúr, Tanjore, the Bareich family, Ferozpúr, Merich, Tansgaon, Nepaní, Akulkote, and those of the Ságar and Nerbudda country; also Sikkim and the states of the northern hills.

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## VII.—Miscellaneous.

### 1.—*Importation of Ice from Boston.*

The arrival of the Tuscany, with a cargo of ice from America, forms an epoch in the history of Calcutta worthy of commemoration, as a facetious friend remarked, in a medal of *frosted* silver. In the month of May last, we received a present of some ice from Dr. Wise at Huglí, (whose efforts have so long been directed to the extension of its manufacture by the native process*,) as a proof that the precious luxury might be preserved by careful husbandry until the season when its coolness was most grateful :—little did we then contemplate being able to return the compliment with a solid lump of the clearest crystal ice, at the conclusion of the rains ! nor that we should be finally indebted to American enterprise for the realization of a pleasure for which we have so long envied our more fortunate country-men in the upper provinces; nay even the beggars of Bokhara, who, in a climate at times more sultry than ours, according to Lieut. Burnes, " purchase ice for their water even while entreating the bounty of the passenger †!" Professor Leslie, with his thousand glass exhausters, and his beautiful steam air-pumps, tantalized us with the hopes of a costly treat, and ruined poor Taylor the bold adopter of his theory :—but science must in this new instance, as on so many former occasions, confess herself vanquished or forestalled by the simple practical discovery that a body of ice may be easily conveyed from one side of the globe to the other, crossing the line twice, with a very moderate loss from liquefaction.

We are indebted to Mr. J. J. Dixwell, the agent for the proprietors, for the following interesting particulars relative to the Tuscany's novel cargo, and the mode of shipping ice from America for foreign consumption.

The supplying of ice to the West Indies and to the Southern States of the Union, New Orleans, &c. has become within these few years, an extensive branch of trade, under the successful exertions of its originator Frederic Tudor, Esq. of Boston, with whom S. Austin, Esq. and Mr. W. C. Rogers are associated in the present speculation.

* See page 80 of the present volume, and former notices in the Gleanings.

† Journal, vol. ii. p. 229.

The ponds from which the Boston ice is cut are situated within ten miles of the city. It is also procured from the Kennebec and Penobscot rivers in the State of Maine, where it is deposited in ice houses upon the banks, and shipped from thence to the Capital. A peculiar machine is used to cut it from the ponds in blocks of two feet square, and from one foot to eighteen inches thick, varying according to the intensity of the season. If the winter does not prove severe enough to freeze the water to a convenient thickness, the square slabs are laid again over the sheet ice, until consolidated, and so recut. The ice is stored in ware-houses constructed for the purpose at Boston.

In shipping it to the West Indies, a voyage of 10 or 15 days, little precaution is used. The whole hold of the vessel is filled with it, having a lining of tan about four inches thick upon the bottom and sides of the hold, and the top ~~lifts~~ covered with a layer of hay. The hatches are then closed, and are not allowed to be opened till the ice is ready to be discharged. It is usually measured for shipping, and each cord reckoned at three tons: a cubic foot weighs 58$\frac{1}{2}$lbs.

For the voyage to India, a much longer one than had been hitherto attempted, some additional precautions were deemed necessary for the preservation of the ice.

The ice-hold was an insulated house extending from the after part of the forward hatch to the forward part of the after hatch, about 50 feet in length. It was constructed as follows:

A floor of one-inch deal planks was first laid down upon the dunnage at the bottom of the vessel: over this was strewed a layer one foot thick of tan, that is, the refuse bark from the tanners' pits, thoroughly dried, which is found to be a very good and cheap non-conductor; over this was laid another deal planking, and the four sides of the ice-hold were built up in exactly the same manner, insulated from the sides of the vessel. The pump, well, and main mast were boxed round in the same manner.

The cubes of ice were then packed or built together so close as to leave no space between them, and to make the whole one solid mass: about 180 tons were thus stowed. On the top was pressed down closely a foot of hay, and the whole was shut up from access of air, with a deal planking one inch thick, nailed upon the lower surface of the lower deck timbers; the space between the planks and the deck being stuffed with tan.

On the surface of the ice, at two places, was introduced a kind of float, having a guage rod passing through a stuffing box in the cover, the object of which was to note the gradual decrease of the ice as it melted and subsided bodily.

The ice was shipped on the 6th and 7th of May, 1833, and discharged in Calcutta, on the 13th, 14th, 15th, and 16th September, making the voyage in four months and seven days.

The amount of wastage could not be exactly ascertained from the sinking of the guages, because on opening the chamber it was found that the ice had melted between each block, and not from the exterior only in the manner of one solid mass as was anticipated. Calculating from the rods and from the diminished draught of the ship, Mr. Dixwell estimated the loss on arrival at Diamond Harbour to be fifty-five tons. Six or eight tons more were lost during the passage up the river, and probably twenty in landing. About one hundred tons, say three thousand maunds, were finally deposited in the ice house on shore, a lower room in a house at Brightman's ghaut, rapidly floored and lined with planks for the occasion.

The sale has not, we believe, been so rapid as might have been expected, amounting to no more than ten maunds per diem, although Mr. Rogers has fixed the price at the low rate of 4 annas per seer, one half the price estimated for the Huglí ice, which was still calculated to be somewhat cheaper in proportion than saltpetre. The public requires to be habituated to it, and to be satisfied of the economy of its substitution for the long established process of cooling. There may also be some doubts of the best mode of preserving so fleeting a commodity, but on this head we cannot but advise an imitation of the methods pursued on a large scale on board of the Tuscany. For the application of the ice to the purposes of cooling ample directions have been given in the Gleanings of Science, vol. iii. p. 120. A box, or basket, or tin case, with several folds of blankets, or having a double case lined with paddy chaff or any non-conducting substance, will preserve the ice until wanted, and for cooling water or wine the most effectual method of all is to put a lump of the clear crystal into the liquid : the next best is to spread fragments upon the bottles laid horizontally, and leave them wrapped in flannel for a couple of hours.

So effectual was the non-conducting power of the ice-house on board, that a thermometer placed on it did not differ perceptibly from one in the cabin. From the temperature of the water pumped out, and that of the air in the run of the vessel, Mr. Dixwell ascertained that the temperature of the hold was not sensibly affected by the ice. Upon leaving the tropic and running rapidly into the higher latitudes, it retained its heat for some time, but after being several weeks in high latitudes, and becoming cooled to the temperature of the external air and sea, it took more than ten days in the tropics before the hold was heated again to the tropical standard.

Mr. Dixwell has favored us with a sight of the daily register kept by himself on board, which we regret we have not space to insert at length :—The following extracts however will serve to impart some of the useful information gleaned in this first experimental passage from Boston : we sincerely hope and believe that it will afford ample encouragement for a repetition of the speculation, and eventually for a regular annual consignment of this new staple produce of the northern continents ! a scheme is now in circulation for supplying ice all the year round at 2 annas per seer.

*Extracts from the Log of the Ship Tuscany.*

| Date. 1833. | | Latitude at noon. | Longitude at noon. | Temp. of air. | Temp. of water. | Fall of Ice-guage. | Wind. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | | ° ′ | ° ′ | ° | ° | inches. | | |
| May | 13 | 41 30 N | 66 44 W. | 61 | — | | S. W. | moderate. |
| | 16 | 39 26 | 54 51 | 64 | 70 | | N. W. | fresh. |
| | 20 | 34 24 | 43 00 | 70 | 68 | | W. | ditto. |
| | 24 | 27 48 | 33 44 | 71 | 73 | | N. E. | av. temp. in N. temperate zone. |
| | 28 | 20 48 | 30 29 | 78 | 76 | | E. | air 68.3—water 72.3. |
| June | 1 | 13 05 | 25 33 | 80 | 79 | 4 | N. E. | light airs. |
| | 6 | 7 29 | 19 51 | 86 | 85 | | N. E. | ditto. |
| | 16 | 0 52 | 18 05 | 84 | 83 | 7.1 | S. E. | average temp. of N. tropic. A. 82° |
| | 19 | 4 04 S | 22 21 | 82 | 80 | | S. E. | W. 81°.5. |

[Having occasion to open the run scuttle, found the air pouring up from the hold quite warm : a therm. which stood at 80° in the cabin, rose to 84° in the run.]

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | 23 29 | 28 29 | 76 | 73 | 9.2 | E. | av. temp. S. tropic. A. 79°.9 W. 79°.0. |

[July 2, bored with an auger into the ice house, under the main hatch, and came to ice at 10 inches from the top. Cargo as usual dry.]

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| July | 4 | 29 38 | 19 38 | 72 | 70 | 0 | W. | fresh winds. |

[Instead of the usual 10 minutes pumping, required an hour to free the ship from water owing to cranckness, and having bcen 20 days on one tack. She has been pumped out generally 4 or 5 times, or about 170 strokes per diem.]

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 15 | 38 53 S. | 12 27 E | 51° | 56° | guage. | S. W. | [current |
| | 18 | 39 22 | 23 10 | 68 | 70 | 11.5 | N. W. | in the warm Cape |

[Since leaving the trades, the water pumped from the hold has been 2° to 5° warmer than the sea.]

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | 39 33 | 63 00 | 61 | 60 | 13.2 | W.N.W | moderate. |
| Augt. | 6 | 28 35 | 83 01 | 62 | 65 | 14.3 | S. | ditto. |
| | 17 | 5 18 | 85 45 | 86 | 86 | 24.0 | calm. | in cabin 83° in run 78°.5 |
| | 19 | 4 36 | 85 28 | 89 | 86 | 24.0 | do. | 83 81 |
| | 21 | 2 34 | 85 14 | 89 | 86 | 25.0 | do. | 84 82 |
| | 23 | 0 59 | 84 57 | 89 | 86 | 25.0 | do. | 83 84 |
| | 29 | 11 23 N. | 85 34 | 88 | 84 | 26.5 | S. W. | fresh. |
| Sept. | 1 | 20 14 | 87 08 | 86 | 86 | | S. W. | ditto. |
| | 3 | Diamond | Harbour. | 88 | 88 | | S. W. | light. |

Average temperature of S. Tropic Indian Ocean, Air 81°.33 Sea, 81°.39
N. Tropic to Diamond Hr. 86.4 85.35
Average temperature of the whole voyage, Air 73.89 Sea, 74.17
Do of former voyages—

| | |
|---|---|
| 6 June to 18 Sept. 1827 | 71.71 |
| 16 June to 6 Oct. 1828 | 71.28 |
| 15 June to 18 Oct. 1829 | 70.16 |
| 2 Aug. to 18 Dec. 1830 | 71.52 |
| 22 Aug. to 16 Jan. 1831-2 | 74.57 |

## 2.—*On the Action of various Lights upon the Retina. By Sir* D. Brewster.

When the eyes are exposed to strong lights, objects cannot be seen of their true colours, and even lights of ordinary intensity produce a decided deterioration in the tints of a fine picture. Hence it is that we see paintings to most advantage when we view them through two blackened tubes held close to the eye. By this means the colours are not only more brilliant, but faint lights are brought out which would otherwise have been overpowered by the action of lateral light upon the retina. If we turn a picture upside down, and look at it with the head inverted, a similar effect is produced, because the image is received upon a part of the retina which is not so frequently used; and it is for the same reason that the colours of the sky and of the landscape near the horizon are so beautifully seen by looking at them either between the legs, or beneath the arm with the head inverted.

It is well known that the human complexion is seen to greater advantage in candle, than in day-light, unless the complexions are very ruddy. This arises from there being so much more red in candle, than in day-light. There are certain states indeed, of the atmosphere, when dark-blue clouds prevail, in which the ordinary complexion appears to great disadvantage; and persons in variable health are often described as looking ill, when the change arises from the prevailing colour of the clouds.

When gas-lights were first introduced, it was a common complaint among those who frequented the theatre that they injured the personal appearance of the audience. This bad quality made them so unpopular, that a red colour was communicated to the light by inclosing it in a reddish coloured glass. The effect, however, arose from the great quantity of light which was used, and from its influence upon the retina; and if the same intensity of light had been obtained either from oil or from candles, the same effect would have been produced. Our eyes are now so much accustomed to the use of strong lights that the retina is not so easily rendered insensible to the red rays, and the blue colour of the light is no longer complained of. It is, however, still observed, by those who have been for the first time exposed to gas illumination, and the eyes of such persons must therefore serve an apprenticeship before they learn to see objects in their true colours.

The blue colour of gas-light was ascribed to the badness of the gas; and the apparent removal of this injurious quality has been attributed to its increased purity and to improved methods of burning it: but the truth is, that bad gas, or an imperfect combustion of good gas, produces a much redder light than good gas burnt in the best manner. The smoke which is produced in the former cases invariably reddens the flame, and its perfect removal causes the gas to approximate to the light of the sun, which is always bluer than that of the whitest flames from wax, oil, or tallow.

There is a very pretty experiment illustrative of some of the preceding observations, which is easily made. Place two candles at the distance of two or three feet from the eye, and about one foot from each other, and having closed one eye, fix the other intently upon either of the candles, as if it were examining with attention some point of the wick. The other candle will be seen by indirect vision, and after a little time, it becomes much brighter and bluer than the first, in consequence of the part of the retina on which its light falls being more susceptible than the more frequently used portion in the axis of the eye, upon which the light of the second is incident. The higher degree of excitation of the retina, produced by the candle seen indirectly, renders that portion of the membrane less sensible to the red rays; and if the excitation is continued, the image will become actually blue, and will be surrounded with a halo of yellow nebulous light. The blue image, indeed, will sometimes disappear, and leave nothing in its place but a nebulous hole.—*Phil. Mag. March*, 1833.

### 3.—*Substances contained in Opium*

M. Pelletier in an elaborate memoir on opium printed in the *Annales de Chimie*, mentions the following principles as contained in opium; viz. narcotine, morphia, meconic acid, meconine, narceine, caoutchouc, gum, bassorine, lignine, resin, brown acid, and extractive matter, fixed oil, and a volatile, but non-oleaginous principle, which rises in distillation with water.

Added to these substances, M. Beter announces (Journal de Pharmacie, April, 1832), another peculiar principle; it is bitter, crystallizable, forms salt with acids, especially with acetic acid, with which it gives crystals in the form of very white scales, and with sulphuric acid, white silky crystals; no name is given to this substance by its discoverer.

M. Robiquet, it also appears, has separated a new alkali from opium, which he calls paverin. Only a few details of its properties are yet given (Journal de Pharm. Nov. 1832). It differs very remarkably from other vegeto-alkalies in being soluble in water; saturates acids, is insoluble in potash, and contains much azote; it is very poisonous, and acts very particularly on the spinal marrow.—*Phil. Mag.*

### 4.—*Death of Captain J. D. Herbert.*

It is with feelings of sincere grief that we record the loss of our most worthy friend and late coadjutor, Captain J. D. Herbert, at Lukhnow on the 24th instant. He had been for some time suffering under the effects of the climate: a sudden determination of blood to the head was the immediate cause of the fatal event.

## *Meteorological Register, kept at the Assay Office, Calcutta, for the month of September,* 1833.

| Day of the month. | Barometer reduced to 32° Farh. At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10½ P. M. | Thermometer in the Air. Minimum at 4½ A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | Depression of moist-bulb Thermometer. At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10½ P. M. | Hair Hygrometer. At 10 A. M. | At 4 P. M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ,478 | ,520 | ,430 | ,471 | 80,2 | 86,0 | 96,0 | 85,0 | 84,0 | 2,7 | 4,0 | 4,0 | 3,0 | 95 | 96 | 0,37 | o. | S. | o. | cumuli. | cistr. rn. | close. |
| 2 | ,444 | ,490 | ,400 | ,476 | 81,5 | 84,4 | 85,2 | 83,8 | 83,0 | 2,1 | 3,8 | 3,7 | 3,2 | 99 | 98 | 1,40 | o. | S. | S. | settled | rain | all day. |
| 3 | ,429 | ,477 | ,430 | ,499 | 82,4 | 85,2 | 88,8 | 86,1 | 82,4 | 3,4 | 3,4 | 3,5 | 2,1 | 96 | 97 | | s. | s. w. | N. | strat. | overcast. | cum. nimb. |
| 4 | ,483 | ,576 | ,504 | ,582 | 79,2 | 84,3 | 90,2 | 86,4 | 82,0 | 1,2 | 3,2 | 3,9 | 3,8 | 97 | 95 | 0,60 | s. e. | e. | S. E. | do | rain. | cumuli. |
| 5 | ,570 | ,628 | ,521 | ,610 | 79,4 | 85,2 | 89,8 | 86,1 | 80,2 | 1,9 | 3,4 | 3,5 | 2,0 | 98 | 96 | 1,20 | s. e. | e. | E. | rain. | cumuli. | quite clear. |
| 6 | ,570 | ,645 | ,541 | ,639 | 80,0 | 84,5 | 90,1 | 85,7 | 81,9 | 1,3 | 3,4 | 3,7 | 3,3 | 98 | 97 | 0,20 | e. | e. | E. | clear. | fair. | clear. |
| 7 | ,600 | ,676 | ,587 | ,671 | 80,0 | 85,1 | 91,3 | 87,5 | 82,1 | 4,7 | 4,2 | 5,7 | 3,6 | 95 | 91 | 0,08 | e. | E. | E. | stratus. | do | do |
| 8 | ,624 | ,697 | ,614 | ,675 | 79,0 | 85,5 | 91,4 | 88,5 | 81,2 | 4,2 | 4,2 | 4,8 | 2,6 | 95 | 94 | | e. | s. w. | s. | cumuli. | stratus. | do |
| 9 | ,664 | ,743 | ,627 | ,720 | 80,2 | 85,6 | 91,3 | 88,9 | 82,8 | 2,2 | 5,0 | 5,7 | 4,0 | 93 | 91 | 0,20 | s. | s. | s. e. | clear. | fine. | do |
| 10 | ,685 | ,761 | ,630 | ,730 | 81,0 | 85,8 | 96,0 | 90, | 84,2 | 2,0 | 5,2 | 6,0 | 3,7 | 93 | 90 | | s. | S. | S. | do | do | do |
| 11 | ,678 | ,763 | ,633 | ,741 | 82,2 | 87,2 | 94,0 | 90,4 | 84,2 | 2,2 | 4,0 | 5,5 | 4,0 | 95 | 90 | | s. | s. | S. | do | do | do |
| 12 | ,712 | ,769 | ,662 | ,734 | 82,2 | 87,3 | 93,3 | 89,5 | 83,7 | 2,7 | 5,0 | 6,5 | 4,5 | 94 | 90 | | s. | s. | S. | do | clear. | do |
| 13 | ,676 | ,750 | ,648 | ,677 | 81,8 | 86,5 | 92,8 | 90,0 | 83,8 | 6,4 | 5,3 | 7,2 | 4,8 | 93 | 89 | | S. | w. | S. | do | do | do |
| 14 | ,647 | ,700 | ,570 | ,618 | 83,2 | 86,8 | 93,7 | 91,5 | 79,0 | 4,7 | 5,0 | 6,2 | 3,0 | 93 | 91 | | S. | s. w. | s. | do | do | rain th. l. |
| 15 | ,604 | ,657 | ,564 | ,622 | 81,3 | 87,7 | 95,8 | 92,0 | 85,6 | 2,6 | 4,6 | 5,4 | 3,0 | 95 | 93 | | S. E. | s. w. | s. w. | do | do | hazy. |
| 16 | ,615 | ,701 | ,600 | ,662 | 83,3 | 87,5 | 94,0 | 91,5 | 84,5 | 2,2 | 4,5 | 5,6 | 3,5 | 95 | 92 | | S. | S. | S. | dark. | do | clear. |
| 17 | ,624 | ,702 | ,583 | ,649 | 83,1 | 87,5 | 93,6 | 91,1 | 82,2 | 2,4 | 5,0 | 7,5 | 2,4 | 95 | 88 | | s. | S. | S. | nimbi. | do | do |
| 18 | ,622 | ,660 | ,558 | ,664 | 82,0 | 87,5 | 101,3 | 92,5 | 84,2 | 2,7 | 5,0 | 10,0 | 4,2 | 93 | 83 | | s. | s. w. | S. | clear. | do | do |
| 19 | ,644 | ,688 | ,603 | ,695 | 82,4 | 88,2 | 93,2 | 89,5 | 83,2 | 2,6 | 5,4 | 6,3 | 3,5 | 92 | 99 | | o. | s. w. | s. e. | do | do | do |
| 20 | ,674 | ,737 | ,601 | ,667 | 81,8 | 87,5 | 95,7 | 91,1 | 83,4 | 3,0 | 5,4 | 8,2 | 3,9 | 92 | 87 | | o. | s. | s. | do | cumuli. | bank s. w. |
| 21 | ,625 | ,671 | ,547 | ,623 | 83,0 | 88,8 | 102,0 | 91,6 | 84,3 | 2,8 | 6,2 | 8,2 | 3,3 | 91 | 86 | | o. | n. w. | o. | do | fair l. | threatening. |
| 22 | ,576 | ,622 | ,534 | ,619 | 82,6 | 87,6 | 93,2 | 85,2 | 82,0 | 2,5 | 4,5 | 4,8 | 2,0 | 96 | 95 | 0,82 | n. | n. e. | s. e. | do | rain. th. | haze. |
| 23 | ,590 | ,634 | ,542 | ,612 | 81,2 | 86,6 | 90,2 | 85,5 | 80,3 | 2,5 | 4,3 | 4,3 | 2,1 | 95 | 97 | 0,48 | E. | n. | E. | nimbus. | cum.rn.th. | threatening. |
| 24 | ,563 | ,652 | ,546 | ,634 | 80,0 | 85,4 | 89,9 | 86,7 | 80,0 | 1,3 | 4,2 | 4,5 | 2,0 | 96 | 96 | 0,10 | E. | E. | E. | dark. | overcast. | cir. above-fixed. |
| 25 | ,593 | ,662 | ,552 | ,632 | 79,1 | 85,4 | 89,0 | 85,0 | 82,6 | 2,0 | 3,7 | 3,8 | 4,0 | 96 | 97 | 0,60 | n. e. | n. e. | S. E | do | do | cirri. |
| 26 | ,606 | ,631 | ,538 | ,610 | 79,5 | 85,0 | 88,0 | 84,2 | 81,3 | 2,2 | 3,8 | 3,3 | 2,5 | 99 | 88 | 1,22 | E. | s. e. | S. E. | cumulus. | rain. | cir. cum. |
| 27 | ,574 | ,611 | ,498 | ,580 | 80,0 | 85,7 | 99,0 | 89,1 | 82,0 | 1,9 | 4,5 | 6,7 | 3,0 | 95 | 89 | | E. | S. | S. E. | clear. | clear. | very clear. |
| 28 | ,524 | ,567 | ,460 | ,567 | 80,2 | 86,7 | 103,5 | 90,0 | 83,2 | 1,5 | 5,3 | 8,0 | 3,4 | 93 | 86 | | s. e. | E. | S. E. | do | do | cirri. |
| 29 | ,522 | ,586 | ,436 | ,593 | 81,4 | 86,5 | 106,2 | 87,9 | 84,1 | 2,3 | 4,5 | 4,6 | 3,6 | 95 | 95 | | n. e. | E. | E. | do | cum.th.rn. | clear. |
| 30 | ,570 | ,600 | ,500 | ,585 | 81,5 | 85,7 | 86,7 | 86,7 | 83,0 | 3,0 | 3,6 | 4,3 | 3,2 | 97 | 96 | 0,92 | n. e. | n. e. | E. | nimbi. | cum. strat. | do. |
| Mean | 29,593 | ,652 | ,548 | ,612 | 81,1 | 86,3 | 93,5 | 88,3 | 82,6 | 2,6 | 4,4 | 5,5 | 3,2 | 95 | 92 | 8,19 | S. and E. | | | Squally much thunder. | | |

The Instruments for 10 A. M. and 4 P. M. are suspended in the free air of the Laboratory, the Barometer used at those hours stands ,044 lower than the Surveyor General's; the correction for the other Barometer will be given hereafter.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 22.—*October*, 1833.


### I.—*A visit to the Gold Mine at Battang Moring, and Summit of Mount Ophir, or "Gunong Ledang," in the Malay Peninsula. By Lieut.* J. T. Newbold, 23*rd Regt. Mad. L. Inf.*

On the 20th April, I arrived at *Assahan* from *Malacca* on route to Mount Ophir. *Assahan* lies about 31 miles E. N. E. from *Malacca*, and is our most advanced outpost towards the frontier of the independent state of *Muar*. The stockade is situated on the summit of a knoll partially cleared of wood and crowned by cocoanut trees; it consists of a defence of upright piles driven deep into the ground, and is about sixteen yards square, with a low banquette running round; enclosed by this is a small unfinished caserne capable of accommodating thirty men, constructed of *Atap*. The knoll terminates on the north-east and west in a swampy *sawah*, and is approached by a footpath traversing some rough ground from the south; through the eastern part of the *sawah* runs the *Assahan* rivulet, and beyond this is a stretch of forest amid which lies enshrouded Ophir's gigantic foot. *Assahan*, owing to the exactions and tyrannies practised by the petty *Malayan* chiefs around, has been almost deserted by the native population; who are now, however, re-assured by the presence of our troops, slowly returning to their ravaged homes.

At a quarter to one P. M. Lieut. Hawkes and myself left *Assahan*, with a *posse comitatus* consisting of a naique, six sepoys, and six convicts; Amas Karo, the *Panghulu* of *Sunjiedua*, the *Imam* of *Bokko*, Daniel Peters the Portugueze interpreter, Nasep an Abyssinian, and a guide named *Haji*, with ten Malays provided with "*parangs*" to clear a path through the thick underwood and numerous ratans and creepers with which a Malay forest abounds. After travelling along a footpath through a dense jungle for an hour or so, we crossed the frontier into the *Muar* territory. The boundary mark, as pointed out by the Malays, is a large *Bankon* tree growing close to the path on the right hand. After crossing the *Schong* and *Gummi* streams we arrived at the latter place at a quarter-past 3, P. M.

*Gummi* is, or rather was, a small village situated close to the foot of Mount Ophir: it contained about 20 houses, almost all of which have been forsaken by their inhabitants, owing to causes before-mentioned. It does not appear to have ever benefited by excess of cultivation, but probably owed its former population to the proximity of the gold mines, which merit a brief description.

About sixty yards from the deserted hut which constituted our "*Serai,*" nearer the mountain, is a house almost concealed by the sloping ground on which it stands, inhabited by six or seven Chinese miners, and immediately in front of it is a gold mine. This place is called *Battang Moring*. The mine is nearly exhausted; it is situated on the flat marshy ground at the foot of the slope on which the Chinese house stands; in length it measures about ten yards, by four in breadth; and six or seven feet in depth.

It is filled with muddy water, which is drained off by a simple bamboo hydraulic apparatus somewhat resembling the Indian *Pukotah.* The miners descend for the purpose of digging out the metallic earth, by means of rude ladders formed of the notched trunks of trees; a Chinese, who had embraced Muhammedanism, went through the process, which is extremely simple: having dug out a quantity of the earth, which consists of coarse sand, greyish clay and white pebbles, among which crystals of quartz are found, and greenish stones, he placed it in a shallow funnel-shaped vessel of wood, and carried it to a stream of water, conducted by two narrow channels close to the mine.

The water falling from a height of about a foot washes away the lighter earthy particles and clay, assisted by the rotatory motion of the miner's hand. This done, he carefully picks out the stones and other refuse too large for the water to carry off, whilst the gold dust, in minute portions, sinks to the narrow bottom of the vessel, from which it is extracted, carefully washed, and laid by to be made up into small bags each containing one *bunkal,* ($1\frac{1}{2}$ oz. tr.)

The gold of Ophir, though small in quantity, is as fine as that of *Pahang* in quality, being estimated at ninety touch. A gentleman of the Madras Medical Establishment, to whom I showed the crystals and earth, is of opinion that the latter is the debris of the granite forming the summit; the white masses appearing to be felspar in a decomposed state: the crystals are quartz, and the small grains in the earth also quartz. The gold found in it he supposes to be washed down from the mountain as the rock became disintegrated.

The Chinese showed me a specimen of a stratum of clay of a greenish grey colour, beneath which gold is never found; this is the case with the present mine, which they intend quitting to open another a few paces distant.

The Chinese affirm that one mine does not produce monthly more than one *tael* of gold. This is probably designedly underrated. A tribute is exacted from each individual of one dollar monthly for the privilege of mining here, by the petty Malay chiefs, Inches Ahad and Mahmed.

They levy it in person every two months. These two chiefs are nominally under the *Tamangong* of *Muar,* (whose maternal uncles they are,) but in reality are little better than banditti.

I give the following on the authority of the head Chinese miner at *Moung,* as the names of the places around Mount Ophir (for the gold is always procured at the foot), where mines have been established :—

*Battang Moung, Kedanon, Rejang, Kaddam, Tanong, Paeedalum, Berinjin, Terring, Kayo Arro, Kamoyan, Jongi, Deddam, Poggi Baru, Chindagon, Ayer Kuning,* and *Ayer Chamhi.*

He also informed me that, formerly, nearly 1000 Chinese worked in these mines; but that of late, owing to the unsettled state of the country, they had nearly been deserted. The Chinese, who still work at the mines in spite of the oppression they suffer, depend on *Malacca* for their supplies, for which they occasionally dispatch two or three of their number, who take down with them the small portion of gold dust they have been able to scrape together. The wild and deserted state of the country, and the extent of forest to be traversed between the foot of the mountain and *Malacca,* afford opportunities, not unfrequently taken advantage of, by the marauders that infest the frontier, for the sake of the pittance of rice and salt fish, and a few grains of gold dust. Murder is almost invariably added to robbery. Shortly after my visit, two of these Chinese going up to the mines were found murdered, in the heart of the *Rheim* forest on the road; one with his head nearly severed from the body; the corpse of the other lay about 300 paces from that of his comrade: he appears to have sought safety in a vain flight ; his left arm was cut through at the elbow, and body horribly mangled.

We had a fine view of the mountain from *Gummi,* as the clouds which had hitherto wrapt its triple peak in grey obscurity, now rolled off in majestic wreaths, revealing to us Ophir's picturesque proportions.

We started from *Gummi* at 9 A. M. on foot : the Malays went on in advance clearing the path through the low thicket, through which our path now lay, to the banks of the *Jerram* river, along which we waded for some distance ; near this we crossed the track of a rhinoceros. About a mile and a quarter from the river stood the deserted house of a Malay, the last trace of human habitation ; this place the Malays call *Rullowe,* which I believe signifies a place where metal is melted, or the smoke which is produced by fusion ; from this it may not be unreasonable to infer that a mine formerly existed in this vicinity.

A little in advance of *Rullowe* the ascent of Mount *Tando* commences ; this is the longest but most gradual of the three acclivities which constitute the ascent. Having descended this and scaled part of *Gunong Peradap,* we arrived at a steep bank of rock, called *Padang Battu* or *Plain of stone.* On the right of *Padang Battu* the rush of the river *Jerram* down the mountain side was distinctly audible. The surface of the rock is intersected by numerous creepers, which formed a sort of rope ladder we were glad to avail ourselves of. Here we rested a short time, enjoying the extensive prospect this elevated situation afforded. Leaving *Padang Battu* far below, stands on *Peradap's* summit a bluff rock named *Battu Serambi,* which signifies *"the rock of the porch."*

The rock was first mistaken for the peak itself, but on arriving at the bushy platform that crowns *Serambi's* mossy head, Ophir still stood before us, nearer, but steeper and as lofty apparently as ever. A short descent brought us to the bottom of the third and last ascent, viz. *Gunong Ledang.* The trees here are of a stunted and venerable appearance, being for the most part covered with moss and lichens, a thin carpet of which barely conceals the primitive rock beneath : we had lost sight here of animals larger than the smaller reptiles that creep among the decayed vegetable matter beneath our feet.

After passing *Gunong Tando,* the first ascent, elephants' tracks, which were there numerous, were no longer visible. The solitary scream of that singular caricature on the human species, the *"Oonka,"* and the note of the bird *Selanas* on Mount *Paradap,* were the last sounds of animal life the forest yielded.

After a short scramble, in which we were obliged in some places to draw ourselves up by the trees and roots, we attained the summit, from which we caught hasty glimpses through the rolling cloud, fast clearing away, of a magnificent prospect beneath. To the southward the states of *Segamat* and *Muar;* to the north-west the mountains of *Rumbowe* and *Serimenanti;* and to the north-east *Jompole* and part of *Pahang*, celebrated for its gold. Turning westwards lay the ruins of the ancient church of St. Paul's, on the flagstaff hill at Malacca, and part of the town itself; its bight and the sea coast from Mount Formosa to *Salengore*, the glittering and placid surface of the water enamelled with numerous verdant islets. The view inland presented a vast amphitheatre of thick foliage (with here and there slight bare patches of *sawah* and pasture land), thrown into various shades and tints by the rays of a setting sun.

The extreme apex of the mountain is formed of a block of greyish granite, surrounded by others, lying on a strip of table ground about 40 yards long by ten broad, on which grew some stunted trees, a few of the fir kind, some lichens and mountain shrubs, among which are found the *Petis Patis, Samoot*, the *Russam*, and *Pruik Krek*; the Malays were unable to tell the names of many of the shrubs, never having seen them in the valley.

A thunder cloud growling and flashing a thousand feet beneath us now interrupted the prospect; owing to its influence, probably, the weather had been sultry during the afternoon; the thermometer (Fahr.) although in this elevated situation not sinking below 76° at 4 P. M. at 7 P. M. sunk to 69°, and at half past five A. M. the following morning to its greatest depression 65¼. The height of the loftiest peak above the surface of the sea, as calculated by the thermometer and boiling water, is 5693 feet.

The storm gradually ascending the mountain's sides induced us to seek shelter under an extraordinary overhanging rock, a short way under the summit, called *Battu Seroodang*.

The thunder storm had abated and finally ceased a little after sunset, when a host of fire flies, sole possessors of these heights, contending with the stars in liquid brilliance, floated around us, now soaring to the loftiest peak (for we had taken up our bivouac for the night at the foot of the rock near the summit) now sinking and gradually lost, sparkling and twinkling as they went, in the dizzy depths below. The Malays who were with me, complained much of the cold during the night and particularly before sunrise; but a brisk walk down the mountain side, which brought us in little more than three hours to *Gummi*, effectually did away with the cause of complaint.

Whether the mountain just described, or its namesake on *Pulo Percha* or Sumatra, called by Malays *Gunong Passaman*, or the Ophir of Bruce in *Sofala* on the *Mozambique* coast, or Jamison's Ophir on the S. E. coast of Africa, be the Ophir of Scripture, or not, must still remain matter of doubt.

To the admirers of the marvellous I would recommend the careful perusal of San Mahmed's wonderful adventures, in his ascent to the summit of the mountain to entreat the hand of the enchanted princess of the rock for his master, Mahmed Sultan of Malacca, as contained in the Malayan historical work the *Sillálet-us-Salátin*, and the *Malay Annals*.

Note.—In justice to the mountain I have visited, suffice it here to quote two passages from Dr. Robinson's Theological Dictionary, Art. "Ophir." "Josephus says, that the country of Ophir is in the Indies, and is called the golden country. It is thought he means Chersonesus Aurea, known by the name of Malacca, a peninsula opposite to Sumatra." Lucas Holstenius after many inquiries thinks, "we must fix on India in general, or the city of Supar in the Celebes : again Lipenius, who has composed a treatise concerning the country of Ophir, places it beyond the Ganges at Malacca, Java, Sumatra, Siam, Bengal, Pegu, &c."

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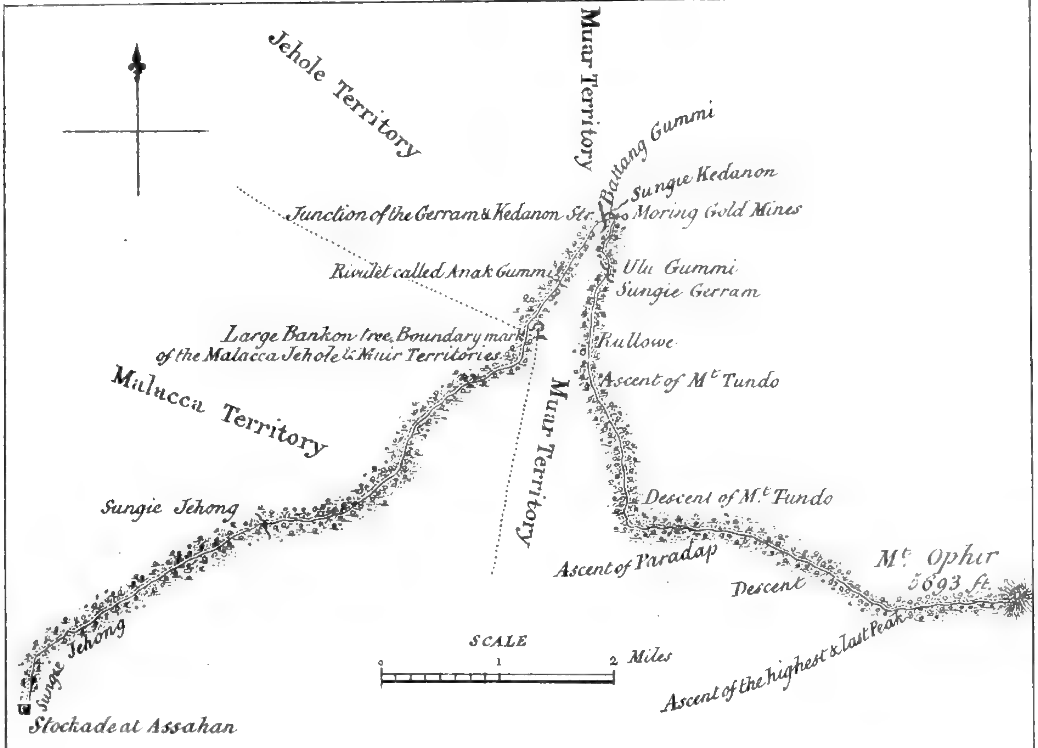
## II.—*On the nest of the Tailor Bird. By Lieut.* T. Hutton, *37th Regt. N. I.*

In Professor Rennie's work on the Architecture of Birds, he gives two accounts of the manner in which the Tailor Bird constructs its nest, and as neither of these appear exactly to coincide with facts which have lately fallen under my observation, I have been induced to offer the following remarks for insertion in the Journal of the As. Soc. At page 258, the professor says:

"The most celebrated bird of this division is the one which in the East is par excellence named the Tailor bird (*Sylvia Sutoria*, Lath.) the description of whose performances we would be apt to suspect for an Oriental fiction, if we had not a number of the actual specimens to prove their rigid authenticity. We do suspect however that these very specimens have misled European naturalists a step beyond the truth in their accounts of its proceedings. 'The Tailor Bird,' says Darwin, 'will not trust its nest to the extremity of a slender twig, but makes one more advance in safety by fixing it to the leaf itself. It picks up a dead leaf and sews it to the side of a living one; its slender bill being its needle and its thread some fine fibres: the lining of the nest consists of feathers, gossamer and down; its eggs are white; the colour of the bird light yellow; its length three inches; its weight $\frac{3}{16}$ of an ounce, so that the materials of the nest and the weight




Route from Assahan to Mount Ophir. by Lt. Newbold.

Nest of the Tailor-Bird (*Sylvia rupicapilla*)

J. B Tassin lith.

of the bird are not likely to draw down a habitation so slightly suspended. A nest of this bird is preserved in the British Museum*."

The second account runs thus:

" There are now three of such nests in the Museum, all of which certainly give some colour to the story of a dead leaf having been sewed to a living one; yet we have the authentic narrative of an eye witness of its operations which mentions nothing of this kind, but on the contrary serves to confirm our doubts. It will consequently be advisable to give this narrative in the language of the original observer, whose splendid figure we shall also take the liberty of copying. Comparing it with the Baya, which we have already described, he says: 'Equally curious in the structure of its nest, and far superior in the variety of its plumage is the Tailor Bird of Hindustan, so called from its instinctive ingenuity in forming its nest; it first selects a plant with large leaves, and then gathers cotton from the shrub, spins it to a thread by means of its long bill and slender feet, and then as with a needle, sews the leaves neatly together to conceal its nest. The Tailor Bird (*Motacilla sutoria*, Linn.) resembles some of the Humming birds at the Brazils in shape and colour; the hen is clothed in brown; but the plumage of the cock displays the varied tints of azure, purple, green and gold, so common in those American beauties. Often have I watched the progress of an industrious pair of Tailor birds in my garden, from their first choice of a plant until the completion of the nest and the enlargement of the young†.' "

In answer to these statements I shall make a few observations on the structure of two of these nests now in my possession, which were found in the garden of Capt. Hearsey, 2nd Local Horse.

The first was neatly formed of raw cotton and bits of cotton threads, woven strongly together, thickly lined with horse-hair and supported between two leaves on a twig of the *amaltás* tree *(cassia fistula)*. These two leaves were first placed longitudinally upon each other, and stitched in that position from the points to rather more than half way up the sides with a strong thread spun from the raw cotton by the bird, leaving the entrance to the nest, at the upper end, between the stalks of the leaves, at the point where they join the branch of the tree. Both of these leaves were of course green and living. Subsequently, however, they were blown down by a high wind, and being now withered, the nest appears enclosed between dead leaves.

Darwin's account therefore will be found to differ materially from mine, inasmuch as the bird neither makes use of a dead leaf in the construction of the nest, nor does it stitch it with fibres, but with strong cotton threads. The lining also of the nest, instead of being "feathers, gossamer and down," is solely of horse hair‡.

* Zoonomia, S. xvi. 13. 3. † Forbes' Oriental Memoirs, i. 55.

‡ Mr. S. P. Stacy has favored us with two specimens in which also the stitches are of spun cotton thread: the nest is of cotton and vegetable fibre.—Ed.

It appears to me that the nest described by Darwin may have been originally constructed of living leaves, and that one of them through some accidental cause, being detached from the branch of the tree and becoming dry and withered, led to the belief of the dead and living leaves being sewed together—and indeed a case of this kind happened in Captain Hearsey's garden, in consequence of which the bird forsook the nest.

I am moreover borne out in this idea by the figure given by Pennant and copied by professor Rennie, in which (as will be seen in the accompanying sketch*), the dead leaf appears to have been detached from a small stalk growing out of the same stem as the green leaf to which the nest is attached. This figure in very similar in appearance to the nest in my possession above described.

The second specimen is more satisfactory still, as in it were found an egg and two young birds nearly fledged†. The nest was at the end of a branch of the *Bhela (semecarpus anacardium)*, about two feet from the ground, and constructed of the same materials as the above, viz. raw cotton, cotton threads, also a little flax, and lined with horse-hair alone: the leaves are stitched together partly with thread prepared by the bird, and partly with spun thread, and so well concealed was it, that even after Captain Hearsey had discovered it (by accident) he could scarcely find it again to shew to me. The young birds were placed with the nest in a trap cage, and thus we succeeded in capturing both the old birds.

I am however of opinion that this is not the kind to which the name of the Tailor Bird has hitherto been applied, but a distinct species.

The following is a description of it:

(Sylvia ruficapilla? *Mihi.*) Length from the tip of the bill to the end of the tail, 5½ inches in one specimen, and four inches in the other; the tail of one is two inches in length, the other 1½ inch, and both appear imperfect. Crown of the head fine rufous red, nape cinereous with a tinge of rufous; back, scapulars, and rump and upper tail coverts, olive green; wings light brown, with a tinge of green at the edges of the outer webs, and a tinge of the same on the upper wing coverts; tail of 12 feathers, narrow, the two middle ones longest, of a lighter brown than the wings and with a faint greenish tinge; the outer feather on each side the tail with a small white spot at the tip. All the under parts are white. On the sides of the throat is a small black stripe, which is only seen when the bird is in motion, wholly disappearing when in a state of rest. Legs slender and flesh coloured. Upper mandible dark horn colour, under one pale; length of the bill half an inch; irides rufous red.

They differ only in length.

* See "Architecture of Birds." Lib. Entertaining Knowledge. † Fig. 3.

The young birds are similar in colours, except that they are paler and the top of the head cinereous with a faint rufous tinge : bill yellowish.

The eggs are white, spotted, chiefly at the larger end, with tawny spots.

They are very lively little birds, exhibiting a good deal of the manner of the creeper tribe *(Certhia)*, carefully searching beneath every leaf, and into every chink and hole for insects, which they seize with great rapidity, flirting their tails up and down, and uttering a sharp reiterated cry.

Now it would follow, the accounts of DARWIN and FORBES being correct, that there is more than one species of bird in India, to which the specific name of *Sutoria* would apply : for instance DARWIN says, the Tailor bird is wholly light yellow, and in this LATHAM agrees with him ; while FORBES on the contrary declares it to vie in colours with the humming birds of the Brazils. It appears to me however that the latter author has confounded the tailor bird with the purpled creeper, *(Certhia purpurata*, LATH), which is the only bird I can remember at all approaching his description. The nest of the purpled creeper is however to me unknown.

That there is more than one species which sews the leaves of plants together to support and conceal its nests, I am almost certain, as a pair of birds, larger than those I have described, have been several times seen frequenting large-leafed plants, among which were discovered the commencement of one or two nests which had been abandoned, apparently from the leaves being blown asunder almost as soon as sewed together by the strong S.W. winds which prevail here. These birds were brown above and dirty white beneath.

The purpled creepers are now becoming plentiful in gardens here, and as I shall pay attention to their habits, and watch them closely, I am in hopes I shall be able to ascertain their method of constructing their nests also.

The description which approaches nearest to my specimens, is that of the "Long Tailed Warbler" of LATHAM ; viz. top of the head pale rufous, hind part of the neck, back, rump, wing coverts and tail, pale olive green ; quills olive brown, tail long, slender, composed of narrow feathers ; the two middle ones as long as the body. Inhabits China.

This is so near, that I can consider mine as none other. I do not perceive a specific name affixed to it, and have therefore given it that of "Ruficapilla." This however can easily be dropped, should the bird have been already *christened.*

**NOTE.** As the two first figures referred to by Lt. H. will be found in the " Architecture of Birds of the Library of Entertaining Knowledge, we have omitted them : the author's own sketch, No. 3, is inserted in plate xviii.—ED.

III.—*An Inquiry into the Laws governing the two great powers, Attraction and Repulsion, as operating in the Aggregation and Combination of Atoms.* *By* Julius Jeffreys, Esq.

[*Continued from page* 464.]

Moreover, there is another source for the sensible heat, in the sudden and forcible compression, which the circumjacent air undergoes, at the moment of the explosion, from which condensation the air itself must evolve heat. The explosion of euchlorine gas, with an evolution of heat, is perhaps a stronger objection, than the former, for it is not attended with a new combination of the elements. This is, however, an objection rather to one of the laws of heat, namely, its becoming latent, than to its materiality, against which, in fact, it is only an indirect objection, by shewing the law, that heat becomes latent in a change to a rarer state, not to be universal. But the whole doctrine of *latent* heat might be imperfect, and yet not invalidate the *materiality* of heat. Nor should an individual exception (supposing it to be such) be considered as subverting a doctrine of so perfect, and almost universal application, as is that of latent heat; much less then does it refute the *material* doctrine, which is not necessarily dependent on the former.

The manner however, in which the above experiment is made, appears to me, as lessening greatly its force, as an exception to the doctrine of latent heat. A small quantity of the gas is used over mercury. As this liquid is incompressible, and so weighty as not to be readily susceptible of sudden motion, it must offer a very great resistance to the instantaneous expansion of the gas, and by this re-action may force out sufficient heat and light to become visible (i. e. a spark or flash); but after the expansion is finished, if much of the gas had been used, it is not improbable, that a fall of temperature would have been evident, in a thermometer introduced.

4. The fact that some gases combine with each other, and form solids, with but a small rise of temperature, as when ammonia combines with many gases, is an objection the reverse of the former; and like it is an exception to the doctrine of latent heat.

It may however be thus explained; that the affinity of such gases, both for heat, and for each other, is so great, that it condenses most of their heat, without evolving it; in the same manner, as when oxygen and nitrogen gases are condensed in nitre.

5. The contraction of clay by great heat, and of water in advancing from 32° to 40° of Fahrenheit, have been considered as objections to the law of expansion, and therefore to this doctrine of heat. The

former however may arise from the great attraction of clay for water; which only the greatest heat can drive off; and of the latter the usual explanation, that it arises from the loss of polarity, which the particles had assumed, appears quite satisfactory. If these be objections, they apply, at least as much, to the theory of vibration; for even were it possible, that an increase of vibration in particles could give rise to expansion, these experiments would show increase of vibration attended with contraction.

6. The combinations and decompositions often effected by the rays of the sun, are certainly not always conformable to the laws of this doctrine of heat; but neither are they to any other doctrine.

7. It has been objected to heat being the cause of elasticity in gases; that this force varies as the density, although in the condensation of gases, much heat is evolved. But this experiment only shews, that, in the condensation of gases, part of their heat is evolved; which if it remained would cause their elasticity to vary in a higher ratio than that of the density.

8. Lastly, it has been objected to the materiality of heat, that notwithstanding the most accurate experiments have been made, it has always been found impossible to ascertain, that it has weight.

This objection however is not valid, since it has neither been possible to weigh light, though few will doubt its materiality, or the materiality of some ether in which its phenomena are seated; which hypothesis merely removes the difficulty of its materiality one step farther. It has also been very justly remarked by a great philosopher, whom I have already quoted, that if this etherial fluid be supposed as much lighter than hydrogen gas, as the latter is than the metal platinum, it could not probably be ascertained to have weight by any means which are known*.

The above are most of the facts, which are considered as objections to the material doctrine of heat, many of which may be sufficiently explained. Much more may be said in support of the doctrine.

As the materiality of light can scarcely be questioned, since Sir Isaac Newton has so ably argued in proof of it, and since on it he has built his system of optics, which could not be founded on any other doctrine, the striking analogy between it and heat, must strongly point out the materiality of the latter. Heat, like light, is radiated from the sun; like light, it travels with exceeding velocity; like light, it is radiated by many bodies, is reflected, is refracted; and according to Berard, is sometimes, like light, polarized. From analogy so strik-

* Sir H. Davy's Elements of Chemical Philosophy, p. 97.

ing as this, some philosophers have been induced to consider them as modifications of the same matter ; or that light, by its actions on bodies, produces the phenomena of heat. But of late years sufficient evidence has been brought of their being separate substances. The experiments of Herschel, and Sir H. Englefield, shewing that heat is not quite so much refracted in the prismatic spectrum as light, whence that much heat is found within the red ray, are a strong proof of this. Nor do the later experiments of Berard (supposing them more correct), which would prove, that the intensity of the heat within the red ray is less than was represented by these philosophers, at all invalidate the argument. For it is only necessary to shew, that *any* heat may travel from the sun, independent of light, to prove a difference between them.

Herschel has also shewn*, that if the red ray be thrown on red glass, the light is transmitted, but nearly $\frac{7}{10}$ of the heat are detained ; and hence, that this appears incompatible with the supposition that the ray is *homogeneous ;* for were it so, the heat transmitted should have corresponded with the light.

The rays from a fire being differently transmitted by glass (those of light being transmitted, but those of heat being most of them detained) is an argument of a similar nature.

Heat is radiated without light by many bodies below certain temperatures, and others, as phosphori, radiate light without heat.

The analogy between light and heat is so striking, that since the former is material, it is almost necessary to consider the latter as such, and yet there is sufficient evidence of a distinction between them.

It is evident from his writings†, that Sir Isaac Newton was of opinion, that the phenomena of heat arise from the action of light on bodies, causing vibrations in a " subtle medium" in them. But it is equally plain that by heat he meant, those phenomena only which are apparent to the senses and commonly called heat. From the very imperfect state of chemical philosophy in his day, the doctrine of calorific repulsion was scarcely taught; and most of the experiments, in proof of the materiality of heat, have been since performed.

This great man has by several passages, especially by some in the 18th query in his Treatise on Optics, suggested the existence of a *highly elastic subtle* fluid, so nearly allied to the matter of calorific repulsion of the present day, that part of this query, with but the smallest modification, is an accurate description of the latter. " If," observes

* Philosophical Transactions for 1800.

† Optics, Query 18.

Sir Isaac Newton, "in two large, tall, cylindrical, vessels of glass inverted, two little thermometers be suspended, so as not to touch the vessels, and the air be drawn out of one of these vessels, and these vessels, thus prepared, be carried out of a cold place into a warm one, the thermometer in vacuo will grow warm as much, and almost as soon, as the thermometer which is not in vacuo. And when the vessels are carried back into the cold place, the thermometer in vacuo will grow cold, almost as soon as the other thermometer."

"Is not the heat of the warm room conveyed through the vacuum by the vibrations of a much subtiler medium than air, which, after the air was drawn out, remained in the vacuum? and is not this medium the same with that medium by which light is reflected and refracted? And do not hot bodies communicate their heat to contiguous cold ones, by the vibrations of this medium propagated from them into the cold ones? And is not this medium exceedingly more rare and subtle than air, and exceedingly more elastic and active? And doth it not readily pervade all bodies*?"

If to these questions were added this one, "And is it not attracted by all particles of all bodies, but with various degrees of force in each?" This medium would at once form the matter of calorific repulsion, and the phenomena of moving heat would arise from its motion and vibration, which must necessarily happen, both from its various affinities, and from its own elasticity tending to an equilibrium of force. Caloric, like this medium, exists, from the minuteness and mutual elasticity of its particles, in what is a vacuum to other bodies. By

* It is a singular circumstance, that some late authors have quoted this passage in order to shew, that Newton was doubtful about the nature of light, and seemed to accord with the theory of tremulous motions in an universal ether, rather than of moving particles emitted from bodies. It is certainly incredible that Sir I. Newton should at the end of his Treatise on Optics, introduce an opinion which would thus overthrow the whole doctrine he had been labouring to establish. Nor is it more probable that entertaining such an opinion, he should have written the 14th section of the 1st book of his Principia, which with it would be nothing more than vain and idle speculation. But the words of the query convey no such meaning. They express an impression upon the author's mind, that the phenomena of refraction, and reflection, are not the effect of attraction or repulsion exercised by the particles of the grosser bodies, commonly called mediums, upon the particles of light, but those of a very far more subtle medium interspersed between the particles of the above-mentioned bodies. Nothing is said implying that this subtle fluid is light itself; on the contrary it is spoken of in a totally distinct character, as a medium, that is, as a substance having a boundary through which light finds a passage, or from the surface of which it is reflected.

the motion and vibration of caloric, or this medium, bodies become of equal temperature. By the atmosphere of caloric round the atoms of bodies, may be effected the reflection and refraction of light, in like manner as this medium is supposed to operate. Caloric, like this medium, is exceedingly more rare and subtle than air, and exceedingly more elastic and active ; for it loses much of its rarity, subtlety, and elasticity when attracted by the gross atoms of gases, which it encompasses, endows with mutual repulsion, and in fact transforms into elastic air. Caloric, like this medium, readily pervades all bodies.

Is not caloric therefore no other than this medium ? and hence, material ?

[Lastly, although we have above seen that a vibration or other motion of the gross particles of bodies cannot in any way account for the *dilating* power of caloric, it does not at all follow that the phenomena of *sensible heat* may not depend on a peculiar condition of the *particles of the matter of heat itself,* such as vibrations in *them* of different degrees of intensity. Hence the absolute quantity of the matter of heat may not always be indicated by the phenomena of sensible heat. And in sudden or violent actions, as those of friction, detonation, and combustion, these phenomena may thus be considerably increased without any increase in the absolute quantity of the matter of heat. In this manner the two leading hypotheses may be united, and the chief difficulties attendant on each being removed, a doctrine, deserving of reception, may be established as a well-digested theory of caloric, in its characters of an expanding and heating medium.]

Having now, I trust, shewn, that the opponent force to the attraction of atoms cannot be a repulsive power inherent in them, but, that it arises from the agency of heat; and that heat cannot be considered as arising from a vibrating motion in the atoms of bodies themselves, but that it is a very subtle fluid, whose particles are possessed of two powers, always inherent in them ; namely, that of repelling each other, and that of attracting all other matter :—having shewn this, the next inquiry which would present itself, is, into the laws governing these two powers of heat, were such a direct inquiry possible.

From the extreme minuteness of the particles of heat, and from their attracting powerfully the atoms of all other matter, it will follow, that every atom of the latter is surrounded by numerous particles of the former ; all of which particles of heat, must tend with great force towards the centre of the atom they surround, and would be in absolute contact with each other, did not their other power (namely, the repulsion which operates between the particles of heat themselves,) prevent their actual contact. Hence they do not form dense masses, but atmospheres round all the atoms of bodies, and endow them with mutual elasticity, which operating against the cohesion of bodies prevents the contact of their atoms.

From this it is manifest, that the mutual repulsion between the particles of heat themselves and their attraction for the atoms of all other matter, are forces which operate against each other; the former tending to expand heat, and the latter forcing its particles near to each other by collecting it around the atoms of bodies in the form of atmospheres, the density of which will vary as the force by which they are detained round atoms varies.

Since, then, these two powers of heat are always operating against each other, no opportunity can be afforded of measuring either of them as a simple force. Since also the atmospheres of heat are always from other causes subjected to compression, the only force, which can be judged of, is a compound repulsion; namely, the elastic force of the particles of heat modified by their other power, attraction, condensing them round atoms.

The ratio in which this compound repulsion varies, must greatly depend on the *force* with which the atmospheres of heat are detained by atoms, and will therefore probably differ in all bodies.

It is however of great importance to obtain so much knowledge of its properties, as may account for the stability of atoms which takes place in the formation of bodies, &c. which must arise from an equilibrium subsisting between the compound repulsion above-mentioned, and the mutual attraction between the atoms themselves.

This investigation, though essentially necessary to a sound explanation of the constitution of bodies in their various states, has not hitherto, I believe, ever been carried on. I shall endeavour to effect it by pursuing the following inquiries:

1st. Whether the repulsion from heat varies in a less inverse ratio of the distance than the attraction of atoms.

2ndly. Whether it varies in the same inverse ratio as the attraction.

And, having shewn that neither of these laws can take place in nature, I shall proceed in a second division to consider the important proposition which remains; viz.

That the force of repulsion with which heat endows atoms, varies in a greater inverse ratio of the distance than the attraction; and to demonstrate that all states and combinations of bodies are satisfactorily accounted for by this law.

1st. Whether the repulsion from heat varies in a less inverse ratio of the distance than the attraction between the atoms of the bodies it pervades.

If this be admitted with respect to the law of repulsion, since attraction varies inversely as the square of the distance, let the repulsive force vary inversely as the distance. And since these two forces must be in equilibrio in any solid whose atoms are at rest, let the following represent the forces operating between any two atoms, A and B, at various distances; and let the atoms be placed at any distance 3, at which point the forces must therefore be in equilibrio.

| *Distances.* | 1 | 2 | 3 | 4 | 5 | &c. |
|---|---|---|---|---|---|---|
| Repulsion, | 96 : | 48 : | 32 : | 24 : | 19,2 : | &c. |
| A | | | B | | | |
| Attraction, | 288 : | 72 : | 32 : | 18 : | 11,5 : | &c. |

Here it is plain, that at distance 3 these atoms can be stationary; but if by the slightest force or agitation they are made to approach each other in the smallest degree, as their mutual attraction becomes stronger than the repulsive force, and increases as they approach in a higher ratio, it is manifest, that A and B will come together, and remain in absolute contact.

Again, if A and B are separated in any degree beyond distance 3, they will instantly lose their adhesion, as now the attraction loses force in a greater ratio than the repulsion.

This law would in fact constitute what is called in mechanics an unstable equilibrium; and hence atoms of matter would soon be either in absolute contact or at infinite distances from each other.

Yet, however, in one of the ablest systems of chemical philosophy, which has ever appeared, we find the following passage; " From the very abrupt transition of steam, from a volume of 1700 to that of 1, without any material increase of pressure, one would be inclined to think, that the condensation of it was owing to the breaking of a spring rather than to the curbing of one." " The last however, " says the author, " is the fact. The condensation arises from the action of affinity becoming superior to that of heat, by which the latter is overruled, but not weakened.

" As the approximation of the particles takes place, their repulsion increases from the condensation of the heat, but their affinity increases, it should seem, in a still greater ratio, till the approximation has attained a certain degree, when an equilibrium between those two powers takes place, and the liquid water is the result*."

* Dalton's New System of Chemical Philosophy, Part 1st, page 149.

This passage exactly proposes the above law, that as particles approach their affinity increases in a greater ratio than the repulsive force, or that the repulsive force varies in a less ratio than the attraction. The inadequacy of this explanation may at once be shewn. If, between the atoms of steam, the attraction has become greater than the repulsion, and if the attraction varies in a greater ratio, i. e. increases faster as the atoms approach than the repulsion, the particles must come into actual contact. The equilibrium spoken of in this quotation, can no more take place than between the forces of the atoms, A and B, in the diagram, should they be once within the point of unstable equilibrium.

It cannot then be a law of the repulsion of heat that it varies in a less inverse ratio than the attraction.

Secondly.—Whether the compound repulsion from heat varies in the same inverse ratio of the distance as the attraction of the atoms of the body.

Supposing it a law of repulsion that it varies in the same inverse ratio of the distance as the attraction, it is evident that if the two forces are equal at one distance, they will also be equal at any other; and if one force be the greater at one distance, it will also be the greater at any other; and therefore likewise, if one force be less than the other at one distance, the same force will be less at any other.

Let us apply this law to the explanation—

First.—Of the constitution of solids.

When any body passes from the liquid to the solid state, it is rightly supposed, that by the abstraction of heat, the attraction is enabled to bring the atoms of the fluid within the distance at which from the form and qualities of those atoms, solidity naturally subsists. But according to this law; as the attraction was more powerful at the greater, it will also be at the smaller, distance; and, in the solid, all the heat would either be expelled or so compressed, that the atoms would be in absolute contact, which certainly is not the case; for all solids are capable of contraction.

Secondly.—Of the constitution of liquids. Although most philosophers admit the existence of an attraction between the atoms of liquids, yet many* consider the liquid state as depending solely on the pressure of the air; without which, all bodies would either be solids or gases.

* Berthollet in his Chem. Statics. Translation by Lambert, page 352—And many others.

This Lavoisier himself has enforced. After some former remarks he continues thus*: "Whence it appears, that without this atmospheric pressure we should not have any permanent liquid, and should only see bodies in that state of existence in the very instant of melting; for the smallest addition of caloric would then instantly separate their particles, and dissipate them through the surrounding medium." This doctrine this great philosopher has supported by experiments on liquids placed in vacuo, which rapidly pass into vapor on the removal of atmospheric pressure.

Although most of these experiments appear to confirm the above doctrine, yet I may state certain objections which appear to me unanswerable. Though most liquids do pass into vapor under the exhausted receiver, yet there are some, such as concentrated sulphuric acid, which scarcely appear to do so. This acid (as is well known in what is named the freezing experiment) by its great attraction condenses aqueous vapor formed in an exhausted receiver, and thus preserves a partial vacuum. It not only remains in the liquid state itself, but also condenses the vapor from the vacuum.

Again. If even all liquids could be shown to vaporize at natural temperatures in vacuo, it would not be any proof of the doctrine, owing to the imperfect nature of the experiment itself. Any liquid under the pressure of the air, must soon be of the same temperature with the air, i. e. endeavour to part with heat with the same force: but as soon as the atmospheric pressure is removed, a great force, tending to expel heat from the liquid, is removed; the effort therefore of the liquid to expel heat becomes less than before, and therefore less than the effort of the circumjacent air. The consequence of this must be, a continual passage of heat from the air to the liquid, and its vapor, which will make the evaporation unlimited. Were it possible to procure a receiver which should not be permeable to heat, there would soon be a limit to the evaporation of a liquid, and the receiver would doubtless remain exhausted. It is certainly true, that under such circumstances, water would not remain a liquid, and a small part of it would pass into vapor, most of it would become ice. But ether, alkohol, and other liquids which would resist freezing, would probably continue as liquids in a receiver impermeable to heat. The receiver of any air-pump is in a similar situation to that of a common pump; except that on the removal of the pressure, *heat* is forced into the former and *water* into the latter, by the very same force; namely, the

* Elements of Chemistry, translated by Kerr, page 56.

pressure of the atmosphere. Hence it would appear, that the pressure of the atmosphere does not so materially affect the constitution of liquids, as is generally supposed ; for, although by compressing them with great force, it resists their passing into vapor, yet it at the same time endeavours to afford them the heat requisite for this transition, though doubtless with less force.

Let us now consider the constitution of a *liquid*, supposing the repulsion from heat and atttraction as varying in the same ratio.

And first.—In a liquid, these two forces could not be equal to each other at any one distance of the atoms ; for since they would also be equal at any other, no resistance whatsoever would be offered to any force, such as that of the atmosphere compressing the liquid into an absolutely dense mass, the atoms of which would be in contact. They would, in fact, constitute, what in mechanics is named an equilibrium of indifference, liable to be destroyed by the slightest extraneous force.

Again : the attraction could not be the greater force at any one distance, for it would also be greater at any other ; and much more then could no liquid exist, for there would be, besides external pressure, this additional force tending to condense the liquid, and no force to resist their action.

Lastly : if the repulsive force be greater than the attraction at one distance, it also will at any other, and this excess of the repulsion over the attraction, might be sufficient to resist also the pressure of the air ; and the constitution of a liquid might be considered as compatible with such a law. But let us examine this more minutely. If the pressure of the air were removed from a liquid, since the repulsion was so far superior to the attraction, it would necessarily expand the liquid without limit ; for it would, at any distance of the atoms, continue the more powerful force. But it has, I think, been above shewn, that there is no evidence of liquids expanding into vapors without any addition of heat. The vapor from a liquid in vacuo is expanded, both by heat assumed from the liquid and by heat forced in by the atmosphere without ; and yet the evaporation of most liquids in vacuo is not instantaneous, as it would be according to such a law. Of some, as sulphuric acid and certain oils, it is at most, exceedingly slow.

There is moreover evidence of the attraction in liquids becoming, on a small separation of their atoms, stronger than the repulsion ; for otherwise no attraction would be apparent in them, nor would their atoms ever be collected into spherical drops ; which can only be effected by the excess of the attraction over the expanding force. This last is a two-fold argument ; for since, on a small separation of the atoms of liquids, their attraction becomes superior to the repulsive force, how is it possible that without any addition to it, this repulsive force should expand them into gases ? And again, since the attraction is the stronger force, when the particles are somewhat removed, if the two forces varied in the same ratio, it has been already shewn that no liquids could exist ; but atoms, so acted upon, must be reduced into masses absolutely dense.

The constitution of liquids then could not be accounted for, if the compound repulsion of heat be supposed to vary in the same ratio as the attraction.

Thirdly.—Of the constitution of gases.

When a liquid passes into the gaseous state, its atoms are so far separated from each other that their mutual attraction is much lessened, but from its great augmentation of bulk, the pressure it is subjected to is greatly increased. Hence, in a gas the chief force opposing expansion, is the pressure of the air ; and to enable it to resist this force, the repulsion must be so augmented as to exceed the attraction by a force equal to the pressure.

It is this excess of the expanding force over the attraction, which is alone capable of being measured.

The experiments of Mr. Boyle, as is well known, tended to shew that the density of gases varies as the compressing force ; and Newton proved that if this be true, the expanding force operating between the atoms, will be inversely as their distances.

But as only the excess of this force over the attraction is capable of measurement, it is plainly this excess of the repulsion which was shewn to vary inversely as the distance between atoms.

If, then, the repulsion from heat and attraction vary in the same ratio, and if this ratio be the inverse square of the distance, any difference between the two forces ought also to vary in the same ratio.

And although this difference in the experiment of these great philosophers, is seen to vary in a less ratio than the inverse square of the distance, yet it will not appear incompatible with this or even some higher power being the real ratio of the repulsion between the atoms of any gas, when it is remembered, that on increasing or lessening the density of a gas, by varying the compressing force ; in the one case much heat is given out, and in the other much is assumed. This must cause the expanding force apparently to vary in a far less inverse ratio, than it otherwise would, if heat did not pass out on increasing, or were not assumed on lessening, the density of a gas.

I am ready indeed to acknowledge, that it is not possible to prove from the constitution of a simple gas, that the two powers attraction and repulsion from heat do not vary in the same ratio ; for the effective repulsion, though (according to this law) superior to the attraction at every distance, may have its force limited by atmospheric compression.

Yet, however, since both in solids and liquids it has been proved that the two forces cannot vary in the same ratio, it may be concluded that they neither can, when a body has assumed the gaseous state, although from the peculiar nature of a gas, it may not be possible directly to prove this fact.

Fourthly.—Of the solution of solids in liquids.

Of all combinations none are more frequent, than the solution of solids in liquids ; and of all states no one is more remarkable, than that of many bodies in solution. Oftentimes a dense solid is disintegrated by the powerful affinity of a liquid ; and yet a very weak combination takes place. A combination, in which most of the characters of the bodies remain, contrary to a well known law of combination.

It is somewhat remarkable, that even Berthollet, who has written very fully and ably on Chemical Statics, should have said very little in explanation of the weakness of the combination in many solutions. The two following are the chief passages in his work, which refer to this important question.

" Solution," he observes, " is therefore the effect of a power which can overcome the resistance of the force of cohesion, and the difference of specifie gravity* : and again, " in reality it (the solvent) exercises a force similar to that of the affinity which produces combinations, and whose effect is limited, in the solution of a solid, by the force of cohesion, &c.†" The late Dr. Murray, while supporting his doctrine of mixed gases, has written more definitely on this subject. " In the solution of a solid," observes this able author, " there are opposed the force of affinity between the solid substance and the solvent, and the cohesion of the solid retaining the solid particles in aggregation ‡." And again he writes : " In the solution of salts in water, the attraction exerted is merely sufficient to give fluidity to the solid and to counteract its cohesion and specific gravity ; the properties are not altered, &c.§"

* Chemical Statics, translated by Lambert, vol. i. 20.

† Ditto, vol. i. 295.

‡ System of Chemistry, vol. i. 40.

§ Ditto, p. 41.

These explanations, however, though perhaps at first sight apparently satisfactory, will not account for the imperfect combinations which generally take place in solution.

It will not be difficult to shew that the cohesion and greater specific gravity of the solid, cannot be the forces, which prevent an intimate combination from taking place. When once the attraction for the atoms of the liquid has overcome these forces, the atoms of salt and water would come into absolute contact and form a most intimate combination.

This is evident from the following considerations :—that, as the atoms of salt separate from each other, their attraction decreases. But, as they approach those of the water, their attraction for the latter, increases in as great a ratio as their own cohesion decreases. Hence, since the attraction for the atoms of the water, when comparatively at a distance from those of the salt, is superior in force to the cohesion of the latter, when near to each other,—much more then would the attraction for the water exceed the cohesion of the salt, when the atoms of the salt have separated from each other, but approached those of the water.

The difference of specific gravity in itself, but an inconsiderable force, does not increase. The effect resulting from all these forces would be, an actual contact of the atoms of the solid with those of the fluid. How much more then, an intimate combination.

This effect can only be prevented, by the repulsive force of the heat; which must operate between the atoms of a solid and those of a liquid, in like manner as between any other atoms. But if the attraction is superior to the repulsion at one distance, it will also be at any other, (according to this law ;) and this superiority of the attraction will increase as the atoms of the solid approach those of the liquid. The intimacy of the combination therefore cannot be prevented by the repulsion, if being already inferior to the attraction, it varies in the same ratio with it.

The solution of solids in liquids and the weak resulting combinations, cannot then be explained, if the force of repulsion be supposed to vary in the same ratio as the attraction. Neither could the *mere condensation* of many gases by liquids be accounted for, as might also be proved.

Fifthly.—Of the solution of liquids in gases.

Although various theories have been proposed, in explanation of the solution of liquids, in gaseous fluids, yet no one is altogether satisfactory, for to each objections may be brought. I shall briefly review them separately, and then inquire whether this fact can be explained, on the supposition, that the repulsive force of heat varies in the same ratio as the attraction. The inquiry will be directed especially to the solution of water in the atmosphere, as being the most familiar and striking instance.

First, that aqueous vapor exists in the atmosphere, solely by its own expansive force. This hypothesis has had two forms. Mr. DALTON has supposed, that between different gases the attraction and repulsive force of the atoms are so nearly equal, that gases are neutral towards each other* ; and therefore, that the air has no effect on its hygrometric vapor, which would exist from its own elasticity equally, whether the air be present or not.

Several objections have been brought against this theory, some of which Mr. DALTON has very ably and ingeniously answered. But there are others, which *cannot* be answered. One of them appears to me alone so weighty an objection, as to render it unnecessary to enter into any besides it,—namely, that if vapor, existing in the atmosphere, were perfectly neutral towards it, then certainly the *density*, and not the *bulk* of the atmosphere, would be increased by the presence of the vapor. But NEWTON has proved that the contrary takes place.

Aqueous vapor increases the bulk of the air, and even so much as to *lessen* its density.

If the vapor and air are quite neutral towards each other, how could the elastic force of the former act against the atoms of the air so as to separate them, which must be the case ; for otherwise the density would be increased in proportion to the vapor present, instead of being diminished ?

Mr. DALTON has endeavoured to answer this objection by the following comparison, which I shall attempt to examine, inasmuch as I am persuaded it is not applicable, though it has been admitted as such by many ; and I may state a refutation of it, which has presented itself to me, and which I do not think has hitherto been proposed.

"Let" (he says) "a tall cylindrical vessel of glass containing dry air be inverted over mercury ; and a portion of the air drawn out by a syphon, until an equilibrium of pressure is established within and without ; let a small portion of water, ether, &c. be then thrown up into the vessel ; the vapor rises and occupies the interstices of the air as a void ; but what is the obvious consequence" ? "Why," he says, "the surface of the mercury being now pressed both by the dry air

* New System of Chemical Philosophy, p. 162.

and by the new raised vapor, is more pressed within than without, and an enlargement of the volume of air is unavoidable in order to restore the equilibrium. Again, in the open air; suppose there were no aqueous atmosphere round the earth, only an azotic one equal to twenty-three inches of mercury, and an oxygenous one equal to six inches, "the air being thus perfectly dry, evaporation would commence with great speed. The vapor first formed being constantly urged to ascend by that below, and as constantly resisted by the air, must in the first instance dilate the other two atmospheres, &c.*"

To this I may object, that in the experiment made on the gases over mercury, this liquid presses on the aqueous vapor as well as on the air; and therefore both of them can re-act against it, and will depress it more than either singly. But in the atmosphere the superincumbent atoms of oxygen and nitrogen (which are according to the theory perfectly neutral towards the vapor), being the compressing force, cannot press on the vapor, and therefore cannot be re-acted against.

Hygrometric vapor could not therefore cause the atmosphere to expand as the vapor does the air in the experiment; for the former vapor does not act on the compressing force of the atmosphere as the latter does on the mercury.

The impact of the vapor against the atoms of the air, would be so transient and occasional (owing to the minuteness and rarity of the atoms), that it is unworthy of notice as an opposition to the rise of the vapor.

Again, Mr. Dalton continues thus: "At last, when all the vapor has ascended that the temperature will admit of, the aqueous atmosphere attains an equilibrium; it no longer presses upon the other two, but upon the earth; the others return to the original density and pressure throughout." To this I may observe;—it is very true, that the others would return to their original density and pressure, but this is an admission which itself destroys the supposed analogy of the experiments, in which, while the vapor is present, the air does *not* return to its original density. Mr. Dalton continues: "In this case it is true, there would not be any augmentation of volume, when aqueous vapor was combined with the air; humidity would increase the weight of the congregated atmospheres, but diminish their specific gravity, under a given pressure." To this it may be replied. It is

* Dalton's New System of Chemical Philosophy, p. 162.

certainly true, that when aqueous vapor was added to the air, it would not (according to this doctrine) increase its volume, but this is likewise an admission which would destroy the analogy of the experiment ; and it even forms an impossibility, with the latter part of the sentence. How is it possible that hygrometric vapor (which is an addition of matter) should lessen the specific gravity of the air, and yet not increase its volume ?

The truth, in short, is, that according to this theory, the hygrometric vapor could not increase the volume of the air, but then it must increase the specific gravity. And since this is contrary to the physical fact, it is manifest, this theory is inadmissible.

Dr. THOMSON has adopted the other form of the hypothesis, that liquids pass into vapor solely by their expansive power. He supposes, that the vapor and air are not neutral (as was once Mr. DALTON's opinion), but elastic towards each other ; and therefore, that water passes into vapor, although repelled by the air. The following objections will, I think, shew, that this theory will not afford a satisfactory explanation of the fact. It is plain, that the mutual elasticity of the air and vapor must be inferior to the elastic force of the vapor of water, otherwise the latter could not pass into vapor. But the elastic force of aqueous vapor, at most natural temperatures, is not equal to more, than $\frac{1}{30}$ of the pressure of the air, which pressure must be supported by the water, and therefore must press on it with a force far superior to the elasticity of vapor, at any natural temperature. And even, if water could pass into vapor, this vapor, being lighter than air, would separate from it and float above, since it repels the air, unless this repulsion be exceedingly weak.

The experiments of PICTET and of DE LUC, shewing that evaporation takes place quite as readily in vacuo, are no proofs, that evaporation in the air arises solely from the elastic force of water. They only shew (what no one will deny) that the expanding power in water greatly *aids* its evaporation. Water, under the atmosphere, is compressed with a force 30 times as great as the strength of its vapor (at most natural temperatures) ; there must then exist an attraction between it and the air, to enable it to evaporate as much as it does in vacuo, when no force is opposing the expansion.

Lastly then, it would appear that the hygrometric vapor must be attracted by the air ; and of an attraction between air and water many presumptive proofs have been already adduced.

But, according to the law, that attraction and the force of repulsion vary in the same ratio, if the former be superior to the latter force, between the atoms of air and water when at a distance, it will also be superior when they are near to each other. Hence this superior attraction would bring the atoms of the two fluids into absolute contact, much more then, into intimate combination.

But hygrometric vapor is in a very weak state of combination. The mere solution of liquids in gases cannot then be explained, if the two forces are supposed to vary in the same ratio.

Sixthly. Of the constitution of mixed aerial fluids. The fact that all gaseous fluids, however different their specific gravities, mix when placed together, has been already noticed in a former part of this essay. I shall now attempt a brief inquiry into the various explanations proposed, to account for this phenomenon. These have been applied chiefly to the constitution of the atmosphere; it being a remarkable instance of a mixture, or solution, of gases in each other.

When treating of attraction, I endeavoured to prove, that between all gaseous fluids an attraction is exerted, with more or less force, at all distances.

That the atmospheres of heat round atoms, must endow them with mutual elasticity, is itself evident; and is proved by the fact, that compound atoms are separated by an addition of heat, as is evinced in the decomposition of bodies by heat.

I shall therefore consider both forces, as operating between all atoms of gases; and inquire whether the nature of mixed gases, can be explained, according to the law, that attraction and the force of repulsion vary in the same ratio; supposing, first, that these two forces are equal between gases; or secondly, that the repulsion is superior; or thirdly, that the attraction is superior.

1.—If between mixed gases, the attraction and force of repulsion are equal.

Mr. Dalton was formerly of opinion, that mixed gases neither attracted nor repelled each other; and he explained the mixture of gases, by their own elasticity expanding each, which occupied the whole space between the atoms of the other, as if it were a void.

This very ingenious theory, which in many respects would give a sufficient mechanical explanation of mixed * gases, has, as is well known, been the subject of various discussions. Among others, the following objections of Berthollet, and Dr. Murray, are doubtless insuperable.

* It has been already shewn under a former head, that this theory cannot afford even a mechanical explanation of the solution of water in the atmosphere.

I shall quote the words of this last author, as being concise. "The repulsion between the particles of any individual gas, is owing to the operation of caloric, and is a necessary attribute of the form in which it exists; and why should there not be the same repulsion between the particles of two bodies in this form? What cause can counteract it, but a chemical attraction exerted between them?" "Besides, if there is no repulsion between the particles of different gases, as Mr. DALTON conceives, what prevents them from entering into combinations, when they approach within short distances, as they must frequently do in the internal movements of a mixed elastic fluid? And if there exists no mutual attraction, how are they under any circumstances, as, for example, by compression, or elevation of temperature, brought to combine? It may be added, that were Mr. DALTON's hypothesis just, two elastic fluids ought, in every case, to diffuse themselves in any space, and mix equally, with the utmost rapidity, each being as a vacuum to every other. Yet this facility of mixing is much dependent on their specific gravity." In many cases it is very gradual*.

Mr. DALTON afterwards did somewhat modify this doctrine. He supposed, that both attraction and the force of repulsion, operate between different gases; but that these forces are so nearly equal, as to have no effect in producing the mixture†.

Many objections against the former doctrine are thus obviated, and the spirit of the theory is preserved‡.

* Mr. DALTON endeavoured to explain this objection away, by an ingenious comparison. Page 175. He argues, that, if a ball of lead, which falls through the air at any given rate, be divided into numerous atoms, it will descend with far less velocity (for gravity increases as the cube of the diameter of any sphere, but the resistance only as the square of the diameter), and therefore that atoms of air must meet with very great resistance; and hence the slowness of the mixture. This is surely not a just comparison; for the atoms of lead are not resisted merely by absolute impact against atoms of air themselves, but by the atmospheres of heat round atoms which fill the void space between them, and must be elastic towards particles of lead, as towards any other particles. If these atmospheres were removed, and only the atoms of the air itself remained (they being kept asunder by some inherent repulsive force, which in conformity with the theory in question, did not operate against the lead), then the lead would probably fall with at least equal velocity, by being extremely divided; as its atoms might descend unobstructed, the air being almost a vacuum to them; for its own atoms probably do not occupy more than $\frac{1}{2000}$ of the whole space. For this same reason, two gases ought to mix with the utmost rapidity: the actual impacts of their atoms themselves being very few. But since they do not mix with such rapidity, they cannot be mutually inelastic.

† New System of Chemical Philosophy, p. 162.

‡ Let it be however kept in mind, that this theory cannot explain the evapora-

To this, however, I may state an objection of another nature, and no less powerful. If these two powers are so equal at every distance, as to neutralize each other, what must be the effect of the smallest addition or abstraction of heat ?

In the one case, repulsion becoming the stronger force, the gases must be totally separated. In the other, the attraction predominating will bring the atoms into contact, much more then into intimate combination.

2. Secondly, That between mixed gases the repulsive force is stronger than the attraction. Under this head may perhaps be placed the last modification of Mr. Dalton's theory. He admits of gases being mutually repellent, but lays down the following maxim on which he explains the mixture. "That every species of pure elastic fluid, has it particles globular and all of a size. But that no two species agree in the size of their particles, the pressure and temperature being the same*."

Hence Mr. Dalton argued, that in a pure gas the atoms being all of a size can remain at rest, as the pressure must be equal throughout. But when a gas of larger atoms is placed on the former, that the pressure of their atoms owing to a difference of size will be irregular and unequal ; and that therefore an intestine motion must ensue, until, the gases having mixed, each can rest on the same base.

Even if the atoms of bodies endowed with their atmospheres of heat were spherical, it is very questionable whether the above doctrine, though evincing much ingenuity, be really applicable.

It is difficult to say what would be the effect of spheres of different sizes pressing on each other. But the atmospheres of heat round atoms are highly elastic, and hence do not press on each other by single points only, as inelastic spheres would ; but must assume some form requisite for general and regular contact ; without mixing. Thus if a long hollow cylinder placed perpendicularly, and closed at the upper end, have the air of a few inches from the top heated ; the atoms of the heated air being enlarged (it might be greatly), and according to Mr. Dalton's theory, pressing unequally on those below, a mixture ought to take place. The heated air ought to descend and diffuse itself completely among the cold air. There is little doubt, however, that no such occurrence would take place ; the heated air would continue above. But let the cylinder be inverted, and the heated air will rise

tion of water, and its lessening the density of the atmosphere. The objections stated under that head still remain.

* New System of Chemical Philosophy, p. 189.

rapidly ; and, even then, a great part will pass through the cold air without mixing with it ; as is plain from the fact, that the hottest air in theatres and heated chambers, is near the ceiling, though it receives its heat below. Yet, in a mechanical point of view, the volumes of air of different temperatures, precisely agree with the different gases of the same temperature, mentioned in the supposition, as far as having their atoms of different sizes.

Dr. THOMSON rejects both Mr. DALTON's and BERTHOLLET's explanation of mixed gases. The opinion which he holds, may be brought under this head. In his System of Chemistry he states it in the following words : " I conceive, that when two gases are mixed, the particles of each are beyond the sphere of the affinity of the particles of the other. If the elasticity be owing to the action of heat, it seems to follow as a consequence, that different gases must be mutually elastic towards each other. But I think that the elasticity itself is sufficient to account for this mixture taking place, without being under the necessity of having recourse to the hypothesis of DALTON*."

To this doctrine, I may be permitted to object, that since the atoms of any simple homogeneous gas, cannot be supposed continually to circulate, if heterogeneous are mutually repellent†, like homogeneous atoms, why should a mixture take place between gases which are of the *same* specific gravity ? But between gases of *different* specific gravity, much less, then, could any mixture take place ! Lest it should be supposed that difference of gravity in gases may depend merely on their ultimate atoms being of different *sizes*, but of the same specific gravity, the atom of oxygen, for instance, being 8 times as large as the atom of hydrogen, let it be remembered, that although their *ultimate* atoms might have the same specific gravity, yet when endowed, and hence enlarged, with heat, their relative size is greatly altered, the atom of hydrogen becomes twice the size of that of oxygen, and therefore has only $\frac{1}{16}$th the specific weight.

There would be no more reason for gases, even of the same specific gravity (supposing such), to undergo a mixture, than for any simple homogeneous gas to have circulation among its atoms continually ; and still less should gases of different specific gravity mix ; and should the latter already be mixed, surely they would in a short time separate. It does not appear then, from all that has been stated, if the

* System of Chemistry, last Edition, vol. iii. p. 35.

† By this expression I mean of course the gases having an effective repulsion between them.

repulsion be superior to, and vary in, the same ratio as the attraction, that the constitution of mixed gases could be accounted for.

3. Thirdly, That between gases, the repulsive force is inferior to the attraction.

After having urged the analogy of a solution of a salt in water, Dr. Murray observes: "It may equally be concluded, that such weak attractions may be exerted between aeriform bodies,—attractions sufficient to counteract their elasticity and difference of specific gravity, without being sufficiently energetic to cause an intimate combination. And this principle explains the constitution of the atmosphere. An attraction of this kind, may be exerted between the particles of oxygen and nitrogen gases, may counteract the difference of their specific gravities, and prevent them from separating from each other; and thus may be accounted for the two facts, which on former hypotheses appeared incompatible, the uniformity of the composition of atmospheric air, and its having no properties different from those of the gases of which it is composed*."

Under a former head† I have shewn, that the explanation which Dr. Murray has given, of a solution of a salt in water is not correct; and therefore the analogy does not hold good between it, as stated, and a mixture of gases. Although the above passage may appear to account sufficiently for a mixture of gases, it will not admit of a close investigation. It will be easy to shew from their writings, that many authors have reasoned, as if attraction and repulsion were supposed to vary in the same ratio, though none have expressed a clear and direct opinion concerning them.

If then (according to this law‡) there exists "a weak attraction sufficient to counteract the elasticity" of gases at any distance, however great, it will also be able to counteract the elasticity at any less distance, however small; and hence, of necessity, to bring the atoms of one gas into contact with those of the other; before which an intimate combination would take place.

Supposing then the repulsive force, operating between gases, to be weaker than their attraction, and to vary in the same ratio with it, the mixture of gases could not be explained, since a perfect combination would ensue on their being presented to each other.

* System of Chemistry, vol. ii. p. 41.

† "The solution of solids in liquids."

‡ That the two forces vary in the same ratio.

Part II.—*Division* 2.

The minute inquiry which I have endeavoured to pursue into the laws of repulsion, I trust has shewn, that this force cannot vary either in a less, or the same, inverse ratio of the distance as the attraction.

That this inquiry has not hitherto been strictly pursued, by the ablest writers on chemical philosophy, is evident from the numerous, and even opposite doctrines, which have been laid down to explain the various states, and degrees of combination, in which bodies exist ; and also from numerous passages throughout their writings. Thus the following quotation from the great Lavoisier will shew at once, that (from want of a sufficient investigation) he reasoned as if the two opponent forces to each other, attraction, and the repulsion from heat, varied in the same ratio.

" We have already seen," observes this eminent writer, " that the same body becomes solid or fluid, or aeriform, according to the quantity of caloric, by which it is penetrated ; or more strictly, accordingly as the repulsive force exerted by the caloric, is equal to, stronger, or weaker than, the attraction of the particles of the bodies it acts upon." And again he writes : " But if these two powers only existed, bodies would become liquid, at an indivisible degree of the thermometer, and would almost instantaneously pass, from the solid state of aggregation, to that of aeriform elasticity. Thus water, for instance, at the very instant when it ceases to be ice, would begin to boil, and would be transformed into an aeriform fluid, having its particles scattered indefinitely through the surrounding space*."

And in another place, he further states that, " without the atmospheric pressure we should not have any proper aeriform fluids ; because, the moment the force of attraction is overcome by the repulsive power of the caloric, the particles of bodies would separate themselves indefinitely, having nothing to give limits to their expansion ; unless their own gravity might collect them together, so as to form an atmosphere†."

It is only a want of due reflection on the laws of the two powers, that could have permitted the first of these passages to exist in the work of such an author. How could the attraction in a solid be greater than the repulsion, without bringing the atoms together ? That they are not in contact, he himself has proved‡. That the other statements

* Elements of Chemistry, (translated by Kerr,) p. 55.

† Elements, p. 56.

‡ Elements, p. 50.

might be true, it is evidently necessary, that repulsion be supposed to vary in the same, or a less, inverse ratio of the distance, than the attraction; either of which has been above proved impossible.

Another author of great merit appears to have written with the same impression. Mr. Dalton argued against Berthollet, that if the mixture of gases depended on an attraction exerted between them, they ought to enter into perfect combination*. This is a just objection, if repulsion be supposed to vary in the same, or a less, inverse ratio of the distance, than the attraction. And neither Berthollet, nor Dr. Murray, had shewn, that either of these suppositions is impossible; nor did they answer this objection of Mr. Dalton's as if they were aware, that the two forces could not vary in the same ratio.

Again, in explaining the nature of mixed gases, Mr. Dalton (as has been already observed) considered the attraction, and force of repulsion, between the atoms of the fluids so nearly equal, that neither force affected the mixture at all†. But then it is necessary to suppose (to the end that neither may affect the mixture of the gases) in addition to the two forces being equal, that they should also *vary in the same ratio*.

For, did they not, one of these forces beyond, or within a certain point, becoming the greater of the two, *must* operate‡.

It would be easy to shew, by quotations from all authors, that none have hitherto pursued the inquiry spoken of above; but it is sufficient to have proved this fact, from the writings of two of the ablest philosophers.

After having maturely considered the various doctrines, and theories, which are taught in the statics of chemistry; I became persuaded, that several of them were far from satisfactory; among them in particular, the doctrines, upon which I have been remarking. And while endeavouring to investigate the cause of their insufficiency, an explanation presented itself to me, which appeared free from all the difficulties, and objections, to which former theories are liable; and which will account for the permanency of all states, and combinations of bodies; namely,—

That the force of repulsion, with which heat endows atoms, varies in a greater inverse ratio of the distance than their attraction.

* Manchester Memoirs, vol. v. part 2.

† New System of Chemical Philosophy, p. 162.

‡ Vide Repulsion varying in a less ratio than attraction, and also the following law.

Let us apply this law,

First.—*To the constitution of solids.*

Let there be a liquid between the atoms of which, owing to a loss of heat, the attraction has become so far superior to the repulsion, as to bring them to that distance, at which solidity naturally subsists. And, since the attraction may be conceived to vary as the inverse square of the distance, and repulsion varies in a higher inverse ratio, let this ratio be the inverse cube of the distance, and let the atoms of the liquid be supposed to have been at any distance 4 from each other, and let the following diagram represent the opponent forces operating between any two atoms, A and B, at different distances.

| *Distances.* | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Attraction, | 576 | 144 | 64 | 36 | 23 | &c. |
| A* | . | *B | *B | . | . | . |
| Repulsion, | 1728 | 216 | 64 | 27 | 13.8 | &c.* |

Here it is plain, since between the two atoms at distance 4 from each other, the attraction is 36, but the repulsion only 27, that these atoms must approach, and will come to distance 3, where both forces are equal, each being 64. The atoms of the body, which is now a solid, cannot come nearer; as at any distance within this, there is an effective repulsion operating, which must keep them at this distance, unless, by abstracting or adding more heat, the point of equilibrium is transferred to a smaller, or greater distance. Thus will be constituted a true mechanical stable equilibrium, and thus the nature of solids, and their contraction, and expansion, are at once explained.

Secondly.—*To the constitution of liquids.*

A true explanation of the constitution of liquids, which has hitherto never been clearly given, appears to be afforded by this doctrine.

In applying this law to the constitution of liquids, a third power must be taken into consideration, namely, the pressure of the atmosphere.

Let it be supposed, that these forces have brought the atoms of a gaseous fluid into the liquid state; and let the following represent all the forces operating upon any two atoms, A and B, of the liquid at various distances†.

* It is evident that these series are not supposed to represent the real forces, but are merely intended to illustrate the doctrine more clearly. The diagram represents the forces acting from one atom only, the relative power being the same, as if the forces of both atoms had been represented.

† Lest when a vapor is passing to the liquid state, any one should attribute the cause solely to atmospheric pressure overpowering the expansive force of the vapor, I may instance the condensation of hygrometric vapor in the air, on a fall

| *Distances.* | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Pres. of the air, | 1 | 4 | 9 | 16 | 25 | 36 | 49 |
| Attraction, | 1024 | 256 | 113.7 | 64 | 40.9 | 28.4 | 20.8 |
| A* | . | | . | B* | * | . | . |
| Repulsion, | 5120 | 640 | 189.6 | 80 | 40.9 | 23.7 | 14.8* |

Here it is manifest, that both the mutual attraction of the atoms, and the pressure of the air, are tending to compress the fluid.

If the former force only operated, the atoms would be at distance 5 from each other; as there the attraction and repulsion would balance each other, and constitute a stable equilibrium. But since the latter force (pressure), operates on the liquid, the atoms are brought nearer to each other, to distance 4 *(e. g)* where the attraction and pressure, amounting together, to a force $(16+64=)80$, are balanced by the repulsive force, which at that distance is also 80. The point of stable equilibrium is thus removed to a smaller distance, where, as long as the same forces operate on the atoms, they can neither approach nor recede of themselves. Again as, in a liquid, the atoms are pressed *within* the distance, at which the attraction alone balances the repulsion, by a force (the pressure of the air), the effect of which is merely to keep the liquid within a certain bulk, it is manifest, that this *external* force does not operate towards keeping any two atoms in particular near to each other. Hence the atoms may move on each other, as long as others supply their place. And thus the peculiar character of the liquid state may be explained.

The remarkable property of a liquid, of collecting itself into drops under certain circumstances, may also be readily explained by this law.

The pressure of the air can have no more effect in forming liquids into spherical drops, than into drops of any other form. The only force, which can effect this, is the attraction of the atoms, which, as in the diagram, though weaker than the repulsion between the neighbouring atoms A and B, must become the more powerful force between any, but neighbouring atoms; and being the more powerful

of temperature. Atmospheric pressure can only act on this vapor (whose atoms are perfectly intermingled with its own) so far as it is endeavouring to expand the air, and can only increase the density of the vapor, until the elasticity of the atmosphere itself prevents its own atoms from approaching nearer to each other, or, in other words, until the vapor is of the same density as the natural density of the air; the force therefore, which in this case reduces the *vapor* into a *liquid,* must be an effective attraction, and in part the gravity of the vapor.

* The first of these forces, the pressure of the air, varies as the square of the distance of the atoms. The second, the attraction, varies inversely as the square of their distance. The third, the repulsion, varies in any higher inverse ratio of the distance, *e. g.* inversely as the cube of the distance.

force, it collects several atoms into a drop, under favorable circumstances.

The gradual expansions and contractions of liquids can also be explained by this law. The distance of the equilibrium is gradually increased, or lessened, by an addition, or abstraction of heat; and whatever difference should exist between the forces at any one distance, a stable equilibrium would be formed at some other, where the atoms would be fixed. The doctrine then, that the force of repulsion from heat, varies in a greater inverse ratio of the distance, than the attraction, affords a happy explanation of the nature and constitution of liquids, and also of their gradual contractions and expansions, with variations of temperature.

Thirdly.—*To the constitution of simple gaseous fluids.*

It has been above remarked, that the pressure of the atmosphere is the chief force opposing the repulsion, in a gaseous fluid. But it has also been shewn, under a former head*, that atoms in a gaseous state attract each other. And this force, though certainly much inferior to the pressure, must aid the operation of the latter.

Let all the forces operating from any atom A towards any other atom B, of a simple gas be represented by the following diagram:

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Dis.* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| Pr. | 1 | 4 | 9 | 16 | 25 | 36 | 49 | 64 | 81 | 100 | 121 | 144 | 169 | 196 | 225 | 256 | 289 | 324 | 361 | 400 |
| Att. | 648 | 162 | 72 | 40,5 | 26 | 18 | 13,4 | 10,1 | 8 | 6,4 | 5,3 | 4,4 | 3,8 | 3,3 | 2,8 | 2,52 | 2,24 | 2 | 1,8 | 1,62 |
| A* | . | . | . | . | . | B* | . | . | . | . | . | . | . | . | . | . | . | B* | . | . |
| Rep. | 11664 | 1458 | 432 | 182 | 93,3 | 54 | 34 | 28,8 | 16 | 11,6 | 9,64 | 6,7 | 5,3 | 4,2 | 3,4 | 2,9 | 2,37 | 2 | 1,7 | 1,45 |

In this case, the atoms of the gaseous fluid will be stationary at distance 6, where the repulsion, being 54, is equal to the united attraction and pressure, (18+36) which are also 54. On removing the atmospheric pressure there being a powerful effective repulsion, the atoms must separate greatly, unto that point at which, from the repulsion varying in a higher ratio than the attraction, a stable equilibrium is established. In the above instance, this is at distance 18, where the attraction and repulsion being each 2, the gaseous fluid will expand no further, although all external pressure is removed.

To this, I am aware, it may be objected, that the air in the receiver of an air pump expands without limit, as long as a portion is removed, and, therefore, that the attraction cannot be equal to the repulsive force at any distance of the atoms.

This however it will be easy to shew is no objection. In proportion as the air expands in the receiver, so does its tendency to part with

* The distance to which attraction is exerted.

heat grow less, (i. e. it falls in temperature,) and hence it rapidly receives heat forced into it from the vessel and external air. The truth of this is evident from the fact, that, during the experiment, the rarefied air at first falls in temperature, but afterwards rises to the same temperature as the external air; and if the exhaustion be again continued, the air again expands, falls in temperature, and therefore again receives heat; and, as long as heat is forced into it, so long must it expand, and the point of stable equilibrium be removed to a greater distance. Were it possible to procure a receiver impermeable by heat, there is every reason to believe, that the expansion of the contained air would terminate after several increments of volume; for it cannot be supposed, that, on the removal of pressure, a gaseous fluid would expand without limit, unless the repulsive force, operating between its atoms, be considered to vary either in the same or in a less inverse ratio of the distance, than their attraction; and since it has been already shewn, that either of these cannot be a law of the repulsion in bodies, in any degree of combination, or in any other state, analogy will show, that neither of them can be a law of the repulsion of atoms in the gaseous state.

Another objection which may be presented, is, the *apparent* fact, that the effective repulsion in gases, varies inversely as the distance of the atoms; for, according to the doctrine which I have laid down, since the actual repulsive force is considered as varying in a higher inverse ratio of the distance than the attraction, and since the attraction is supposed to vary as the inverse square of the distance, the effective* repulsion ought to vary in a higher inverse ratio of the distance than the inverse square; and not therefore only inversely as the distance, as it appears to do. To this I may answer, that, as I have before remarked, an ingress of heat takes place, on removing pressure from the air, and an egress on increasing the compressing force. This reception of heat on the one hand, and loss of heat on the other, must cause the effective repulsion apparently to vary in a much lower inverse ratio of the distance, than it would, did the air always possess the same quantity of heat; and from this cause Mr. Boyle's experiments, and the doctrine I have laid down, contain nothing contradictory.

In like manner, in the case of a body gravitating towards a planet, the force varies inversely as the square of the distance from the centre. But, by varying the quantity of matter in the planet, in some

* The excess of the repulsion, over the attraction; the only force which, in a gaseous fluid, admits of measurement.

direct ratio of the distance, its attraction might be made to vary in any less ratio than the inverse square.

The reader will perceive, that the ratio of the attraction of the planet, in the one case, and the doctrine I have laid down, of the ratio of the repulsion in the other, were both disturbed by the absolute forces varying. In the former case, by the quantity of matter in the planet, in the latter by the quantity of heat in the air subjected to experiment being constantly changed.

And moreover, I may observe, it would appear from later experiments than Mr. Boyle's, as is well known, that the elasticity of the air varies in a somewhat greater ratio, than the density, and therefore that the effective repulsion varies in a higher inverse ratio, than inversely as the distance.

The following quotation from an author in Dr. Rees's Cyclopædia* will strongly corroborate the views I have taken of the constitution of gases. After some former remarks he observes: "Thus also in high degrees of rarefaction, the elasticity is decreased rather more than in exact proportion to the weight or density of the air; whence it may be concluded, that there is a *limit* to its rarefaction, or expansion, so that it *cannot be expanded to infinity.*"

This observation, which is founded on actual experiments of philosophers (and which appears to me a just one) is exactly conformable to the doctrine I have laid down. This doctrine therefore (that the force of repulsion, from heat, varies in a greater inverse ratio of the distance than the attraction) which must be admitted to explain the situation of of atoms, in other states of bodies also, I think, elucidates clearly the nature of gaseous elasticity.

Fourthly.—*To the solution of solids in liquids.*

In applying this law to the solution of a solid in a liquid, it is proper to take into consideration all the forces, which can operate either for, or against the combination.

In a saline, or any other solution, of a solid in a liquid, there are at least, five forces, which must greatly affect the solution. Two of these operate in favor of the solution, and three against it; and in proportion as the former forces exceed the latter so will the combination be the more intimate.

When a salt is immersed in water, it is true, that the cohesion and greater specific gravity of the salt are opposed to the affinity between the water and salt, but these (which as far as I am aware are alone

* Article Air.

mentioned by Berthollet and Dr. Murray) are not the only forces which affect the solution. There are two others, which perhaps have quite as much influence on the extent of the combination; namely, the repulsive force, operating between the atoms of the salt, and the repulsive force between these atoms, and those of water*. It is this last force, which prevents the most perfect combination from ensuing. It has however, been shewn, under a former head, that if this force, (viz. the repulsive force operating between the solid and liquid) varied in the same ratio as their attraction, it certainly could not prevent the atoms of the former, from being brought into absolute contact, with those of the latter.

But, admitting this repulsive force to vary in a higher inverse ratio of the distance, than the attraction, the nature of the solution may be clearly explained in the following manner.

It is plain, that the forces opposed to the solution, are the cohesion, the greater specific gravity of the solid, and that repulsive force which must operate between its atoms, and those of the water. That the forces favoring the solution, are the repulsive force operating between the atoms of the salt itself, and their affinity for those of the water. If when the salt is immersed in the water, the two latter forces united, are more powerful than the three former united, the water must begin to act on the salt. As the atoms of salt separate from each other, the repulsive force operating between them, which is one of the forces favoring the solution, at last loses its effect, owing to its varying in a greater inverse ratio of the distance than the cohesive attraction of the salt, and therefore becoming weaker than the cohesive attraction.

Again, as the atoms of salt and water approach each other, the repulsive force operating between these two bodies, though formerly much inferior to their affinity, owing to its varying in a higher ratio, becomes at last, at a certain point, equal to the affinity. And could the atoms of the salt be brought still nearer to those of the water, the repulsion for the same reason would grow superior to the affinity. It is manifest then, as the atoms of salt and water cannot approach nearer to each other than the point, at which the two powers are equal, that the atoms must rest at this distance from each other: for there the two forces form a stable equilibrium.

And, since the atoms of liquids are endowed with greater atmospheres of heat, than those of solids, this superior repulsive force in them may

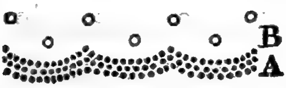
* The repulsive force and attraction operating between the atoms of the water themselves need not be mentioned: as the doctrine may be explained without taking them into consideration.

cause the point of stable equilibrium, between the atoms of the solid and the fluid, to exist at a greater distance, than between the atoms of two solids when in combination, and hence the latter combinations are generally much more intimate than the former.

The solution of solids in liquids and the weak resulting combination, are therefore satisfactorily explained by this doctrine ; which considers the force of repulsion from heat as varying in a greater inverse ratio than the attraction.

Fifthly.—*To the solution of liquids in gases and in the atmosphere.*

Under a former head, I have endeavoured to prove, that the hygrometric vapor of the atmosphere must exist in that state, partly by its own elasticity, and partly by an attraction exerted on it by the air. But it was also proved, that if the repulsion of atoms varies in the same ratio, as the ratio of attraction, the atoms of water would come into actual contact with those of the air ; which cannot be the case, as hygrometric vapor is in the very weakest state of combination with the air. The solution of vapors in gases, without an intimate combination ensuing, may however, I think, be readily explained by the present doctrine.




Let a liquid A be placed under a column of dry air B, which is pressing on it with the usual force of the atmosphere. It is plain that the layer of air nearest the liquid must press on the latter with the whole force of the atmosphere which it supports. But the particles of air are far more distant from each other than those of water ; probably ten times as far. Let us suppose this to be their relative distance. Every tenth particle only of the liquid will be pressed on perpendicularly by the lower stratum of air ; and the condensation of the circumambient heat of this stratum will be so much greater perpendicularly under each particle of air, than obliquely between them, that it will re-act more upon the water directly under those particles, and press it into dimples, as in the figure. The ridges between these dimples will be pressed on laterally by the elastic medium of each aerial particle, but with little force downwards.

All the aerial particles above this lowest stratum must be at a greater distance from those of the water, than the point at which the forces operating between them and the water, are equal. And, being at a greater distance than this point, they must attract the water with more force than they repel it, according to the present postulate. If then the united *effective* attractions of all atoms of air above the lowest stratum, together with the tendency to expand in the water itself, be superior to the gravity of the atoms of water situated in the several ridges, the latter must rise into vapor, and so also must those which supply their place. And the atoms of water, as they rise, will necessarily become intermingled with those of the air, and will be detained among them by their attraction for them. But, since *the repulsion varies in a greater inverse ratio of the distance than the attraction* it will form a stable equilibrium with it, at a certain point, within which it will prevent the atoms of water from approaching those of the air ; that is, prevent an intimate combination from ensuing.

Thus is explained the fact, that an attraction between the air and water may favor the transition of the latter into vapor, and yet not bring the atoms of water into intimate combination with those of the air, a fact, which I do not think can be explained by any other doctrine.

Sixthly.—*To the constitution of mixed gases.*

The minute investigation into the various theories proposed to explain the nature of a gaseous mixture, which I have endeavoured to pursue, has shewn, that each of them is liable to one or more insuperable objections.

It appears to me that *this* phenomenon also, may be explained by the application of the present doctrine.

Having first stated the theorem, I shall endeavour to demonstrate it.

If a cylindrical vessel, of any given length, be filled with hydrogen gas, and inverted (so as to fit closely) over a similar vessel filled with carbonic acid gas ; part of the former gas, although of far less specific gravity than the latter, will descend, and part of the latter will ascend, until the atoms of hydrogen gas, are perfectly mixed with those of carbonic acid gas, and, when mixed, they will not enter into combination.

This may be demonstrated in the following manner.

Since the repulsive force, operating from the atoms of the one gas towards those of the other, varies in a greater inverse ratio of the distance, than their attraction, it must form with this force, at a certain point, a stable equilibrium. Since when the hydrogen gas is placed on the carbonic acid gas, the lowermost atoms, of the former, press upon the upper stratum, of the latter, these contiguous strata, of the two gases, must be brought within the point of equilibrium, between their attraction and mutual elasticity; and must therefore have an effective repulsion for each other.

But, excepting the contiguous strata, all the atoms of the one fluid must be farther from those of the other, than the point of stable equilibrium, and must therefore, exert an effective attraction for them.

If then their mutual effective attraction be superior to their difference of gravity, atoms of hydrogen gas must descend, and of carbonic acid ascend until the mixture is complete. When mixed however, no atom of the former can approach nearer to one of the latter gas, than the distance at which the forces, operating between them, form a stable equilibrium : for within that distance an effective *repulsion* exists. This distance, owing to the great quantity of heat round gaseous atoms, will be so considerable, that the atoms of the two fluids cannot produce on each other those changes, attendant on combination. From which, the gases must be considered, as merely having their atoms detained approximate to each other, by their mutual attraction.

In like manner, may the constitution of the *atmosphere* be elucidated ;—its consisting of gases in a state of mixture, though of different specific gravities, and yet not entering into intimate combination with each other.

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## Conclusion.

The inquiry into the law of the repulsive force, with which heat endows atoms, namely, of that compound repulsion resulting from the opposed action of the two ultimate powers of heat, themselves, which it has been my endeavour to pursue with such minuteness, as the length of this essay would permit, has, I trust shewn, that this power must vary in a higher inverse ratio of the distance, than the attraction.

By way of illustration, I have imagined this ratio to be the inverse cube, that of attraction being the inverse square of the distance ; but I would by no means be understood as intending to enforce this as the actual ratio. Since (as has been above remarked) the actual ratio of this compound repulsion, it is probable, differs in bodies according to the force of their attraction for the particles of heat, it will perhaps never be possible to ascertain it exactly in any individual case. But the limit, which has been laid down, is of the highest importance, since (as I trust) I have deduced from it a simple doctrine, which accounts for the stable residence of atoms at various distances from each other, constituting in nature, solids and liquids, combinations of solids with liquids, liquids with aerial fluids, and mixtures of aerial fluids with each other ; and without which none of these phenomena can be accounted for, but they may even be *demonstrated impossible.*

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## IV.—*Iron Suspension Bridge over the Beosi River, near Ságar, Central India. Pl.* XVI.

We take peculiar pleasure in bringing to the notice of our readers the completion of this work of art, because it has been constructed entirely out of the resources of the country, and being the first attempt at such an adaptation of native material and native workmanship, more than ordinary credit is due to the skilful engineer who planned and executed it, and who moreover, from his long residence in India, could have acquired only a theoretical acquaintance with the system of suspension bridges introduced within these few years, and now so rapidly spreading, in Europe.

The bridge was erected at the suggestion of T. H. Maddock, Esq. agent to the Governor General in the Ságar and Nerbada territories, upon the plans and under the sole superintendence of Major Duncan Presgrave, mint and assaymaster at Ságar.

Engineers in Europe, accustomed to find every thing provided to their wants, can have little idea of the personal labour which devolves upon their brethren of the craft in this country, where to the duties of architect and draughtsman are not only added those of builder and overseer, but the whole of the subordinate trades of the brick-maker, mason, carpenter, and iron-manufacturer ; in a climate too where a trifling exertion produces exhaustion ; and incautious exposure, fever or death : and where the tools must be made and the hands that employ them instructed *ab initio*. We will not say that the native mistrees and labourers are not capable of learning or of working well, especially in upper Hindustán ; the bridge before us is a sufficient refutation of that common and *indolent* remark : but all will agree that a peculiar talent is requisite to manage, instruct, and drill them ; and this faculty is possessed by Major Presgrave in an extraordinary degree. The secret of his influence may be easily traced ;—he is a workman himself : he wields the hammer ; makes and works the lathe ; surveys the ground ; searches the mines ; smelts the ore ; and has all the skill of contriving with the simplest means*, for which the people of this country are themselves so conspicuous.

The Ságar bridge may indeed be called an experiment to try the resources of the country ;—to see whether the iron could be manufactured into bars of a quality fit for bridges ;—and whether these bridges could be made by native workmen who had never wrought or

* As an illustration of this remark, we refer to the description of the rollers on which the chains rest.

even seen iron of the dimensions required. The question has been satisfactorily answered; and even in point of economy, notwithstanding the numberless extra expences incident to a first undertaking, and the distance, eleven miles, of the work from the yard at Ságar, the bridge has been pronounced cheaper than those in Calcutta made with English materials: while of its design and execution no higher encomium can be given than the assurance of the visiting engineer, Major Irvine, that he had seen nothing superior to it in Europe. The Governor General is stated to have expressed equal satisfaction after inspection, and only to have regretted that so noble a bridge should be wasted upon so remote a locality!

We have with permission taken a reduced copy of the elevation and plan, lithographed by M. Tassin, to accompany a private Memoir of the Beosi bridge. The latter authentic source supplies us with the following particulars of the work.

The foundation was laid in April, 1828, and the roadway opened to the public in June, 1830.

The iron of which it is composed is entirely the produce of the Ságar district. When the bridge was projected, it was still in the state of ore in the mines, whence it was extracted, smelted and made into irregular small lumps, in the common native fashion. The working of these crude impure masses into good bars of the requisite dimensions was a matter of very great labour and difficulty.

The bridge is 200 feet in span between the points of suspension.

The piers, resting on the solid rock, six feet under the low level of of the river, are 42 feet high to the roadway; being elevated two feet above the ordinary surface of the country: they have a base of 32 feet by $22\frac{1}{2}$, decreasing upwards in front one in five, and on the sides one in eight feet; which gives on the road a superficies of 21 by 14 feet for each pier. On the sides are wing walls or abutments, running back into the bank 26 feet.

The pillars, or rather arches, of suspension have a base of 21 by 12 feet, admitting a roadway of 9 feet broad. The arches are 15 feet high, and are faced with accurately wrought stone. The points of suspension are elevated 22 feet $4\frac{1}{2}$ inches from the road: the pillars have a total height of 33 feet, and the whole masonry from the rock, 68 feet. The piers and abutments contain 82,488 cubic feet of masonry; the arched standards and bridge parapets, 8900: in all 91,388 cubic feet.

The platform measures 200 feet in length by 12 feet broad, and is calculated to weigh, with the chains, $52\frac{3}{4}$ tons. Supposing the bridge crowded with men, at 69 lbs. per superficial foot all over the platform, the whole weight would be 120 tons, whence it is calculated that the tension to be sustained at each point of suspension would be 85.632 tons.

The suspending chains are 12 in number, arranged in pairs, three pair on either side, two feet above one another. They pass over rollers one foot in diameter, and are securely moored in masonry 16 feet below the surface of the road. The back chains are 101 feet long, rising at an angle of 27 degrees. The angle of the catenarian at the roller is 16° with the horizon : the versed sine at the centre of the curve is 14 feet 3 inches.

The twelve main chains are of round bar iron, one and half inch diameter, bolted together in pairs. They are from 15 to 15.5 feet long, and so arranged that the vertical rods may fall from the joints of each chain alternately in parallel lines five feet apart. The descending chains are square bars measuring $1\frac{1}{3}$ inch on the side : their lower ends pass through 24 conically wrought stones, below which they are capped and keyed. (Figs. 1 and 2.)

The connecting links of the chains, and indeed all the bolt holes in the bars, and the drops, are bored out of the solid iron, and broached to fit the bolts accurately. (Figs. 5, 6.) None were punched at the forge. The bolts are $1\frac{1}{2}$ inch in diameter, and are secured by rings, or washers and keys. Two adjusting links with iron wedges are fitted to each chain, close to the masonry landward, to regulate its curve and dip. (Figs. 7, 9.)

The method of constructing the rollers is thus described in the memoir :

" The iron rollers 12 in number weigh about one cwt. each. They are not solid, but are composed each of about 28 separate pieces of wrought iron, viz. a centre tube or box for the axle over which thick rings are driven ; and an exterior drum between which and the inner ringed tube, flattened bars, as spokes, are driven. The centres were broached out clean and true, and cylindrical axles 3.1 inch in diameter were turned to fit ; the ends of these axles rest on broad thick iron bearings mounted on very strong and solid frames of timber well bolted, clamped and blocked together, covered with pitch cement and secured in the masonry of the pillars." (Figs 7, 8.)

The platform was made in a different mode from those of our Calcutta bridges, as will be understood by the following explanation:

" From the short links set between the centre plates of the shackles (of the main chains), are suspended alternately from each tier, 74 vertical round rods one inch in diameter connected to a short link (Fig. 6) by a one-inch round bolt passing through it and the socket at the upper end of the bar ; at their lower ends the rods have eyes, through which doubled loops of iron pass (3, 4) for sustaining the flat bars or girders, set on their edges and proceeding from one end to the other on both sides of the bridge.

"The flat bars, four inches broad by $\frac{3}{4}$ inch thick and in lengths of fifteen feet, are joined together at their ends by nicely turned bolts passing through bored holes two inches in diameter; they are adjusted in their height by double wedges, resting on holders that connect the sides of the loops together. The girders are also adjustable in their lengths, the bars that enter the masonry have their ends made broader than the rest of the bars, in which are long openings 2 inches broad to receive wedges. (Fig. 10, 11.)

"Eight timbers in an upright position are set in the masonry of the pillars, having upright grooves or spaces cut through them, and faced with thick plates of iron; through two of these beams each end bar passes, and may be wedged on either side of the timber towards the land as occasion may require; thus is the whole length of girder drawn more or less to either end of the bridge, and also rendered exceedingly tight and steady. The grooves in the timbers towards the river, being about four inches longer than the breadth of the bars, permit them to adapt themselves to their proper directions when drawn lengthwise by the wedges acting against the landward beams; by these means the bars have sufficient play to adapt themselves to the motion of the platform, and all jerks at the pillars are obviated.

"Thirty-seven double joists twelve feet long are, (having their ends notched below for the purpose,) laid on the girders: their centres five feet apart correspond exactly with the vertical rods that pass through them; the joists are composed each of two cheeks a foot in depth and three inches thick, separated at intervals by four blocks of wood of the same height and thickness; all firmly put together with bolts, screws and nuts: two cleats are nailed to each end of the joist on their under sides, whose ends fit flat against the girder and keep all steady.

"Planks sixteen feet in length running longitudinally, each plank stretching rove three spaces, and regularly disposed as to their joints, are spiked down on the joists: in a direction across these and upon them other planks are spiked down, their lengths being the same as the breath of the platform. The planks are all imbedded in a composition of resin boiled in linseed oil, which in laying on is mixed with ashes. The lower planks are three, and the upper ones two and half inches thick: they are only six inches broad to prevent warping, and have two strong square-headed spikes passing through them near their edges, at every crossing of the upper over the lower planks: their points are clinched below the platform, to accomplish which 16,370 spikes, weighing a ton and a half, were used; thus the platform has been rendered extremely strong and firm.

"The better to secure the sides of the platform and the ends of the timbers from the weather, a cornice or moulding of wood is nailed along the outside.

"The hand-rail is trussed, and consists of iron pillars or stanchions; diagonal braces of iron; and a stout wooden rail running from end to end of the platform: the whole put together with screws aud nuts, and adjusting screws for setting up or tightening the diagonal braces whenever required. (Fig. 10.)

"The rise in the platform is (as before stated, nine inches, but the curve of the hand-rail is only three inches, to effect which the stanchions that support the rail are of varying lengths. The rail being four feet six inches above the platform at its connection with the masonry, but only four feet in the centre of the bridge."

The following are the weights of the chains, rods, and materials of the platform:

| | *Iron.* *Tons.* | *Wood.* *Tons.* | *Tons.* |
|---|---|---|---|
| 6 double main chains, joints and bolts.............. | 8.5 | | |
| 74 vertical rods, with joints, bolts, &c.............. | 1.385 | | |
| Flat bars and bolts,.............................. | 1.726 | | |
| 37 double joists, blocks, cleats, &c..... ........... | | 6.190 | |
| Bolts, nuts, screws, stanchion plates, flat rings, &c. &c. from beams...................................... | 0.383 | | |
| Planking 1.124 cubic feet, sal wood,................ | | 27.000 | |
| Iron spikes, 16.370 for planking, .................. | 1.467 | | |
| Iron railing trussed, screws, nuts, &c.............. | 1.314 | | |
| Wood for the hand rail, 52 cubic feet,.............. | | 1.479 | |
| 376 feet of cornice to the platform....... ........ | —— | 1.531 | |
| | 14.775 | 36.200 | 50.976 |
| Composition of resin and oil,..................... . | | | 1.745 |
| Total weight hung between the pillars,.... .......... | | tons. | 52.720 |

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## V.—*Additional Note on the Climate of Nagpúr. By* J. Prinsep, *Sec. As. Soc. &c.*

In the May number of the Journal were published the results of Dr. Geddes' Meteorological Observations made in 1831-32 at Kamptí, in the neighbourhood of Nagpúr, which, as observed by the author, were in some degree deficient for the want of a barometer ; the sympiesometer which took the place of that instrument shews by the registers a constant deterioration from the increase of the column of air*, which renders its indication of comparative inutility in accurate calculations. I am now fortunately able to supply the deficiency, of barometrical data, from the copious registers kept by Dr. Wylie at Nagpúr, between the years 1820 and 1830, (with some intermissions,) of which that gentleman was so kind as to permit me to take copies ere he proceeded to Europe.

Dr. Wylie's barometer was filled by himself without boiling. A note in his diary in 1820 states, that it stood 0.235 lower that some other tube (Dr. Voysey's ? ) with which it was compared. In February 1822, the tube was cleaned twice, and fresh mercury added: in May of the same year it was again cleaned. On each of these occasions, the height of the mercurial column was elevated more than a tenth of an

* This is a fault in the sympiesometer which might perhaps be remedied by making the oil-cistern higher, so that the oil should on an average stand on the same level in the two legs of the inverted syphon. In an instrument in my possession after one year, in 1822, the index point had fallen 0.3 inch below the barometer ; in 1823, 0.5 inch ; in 1825, 0.8 ; and now, in 1833, I find it 1.38 inches : Dr. Geddes, according to his register, must have followed the same rate of deterioration : the level in mine is now nearly even with the reservoir.

inch for the time, proving that air or moisture had previously insinuated itself into the vacuum. In November, 1824, a note occurs, at Bombay :— " add .200 to make barometer agree with one afterwards used and found to be more correct." The change of instrument was made in January, 1826 : the new tube was again cleaned and repaired in June and in November* : it broke in May, 1829, and was replaced by one standing full .200 lower. These circumstances were pointed out by Dr. Wylie, as depriving his tables of that measure of exactitude required for deducing the altitude of Nagpúr barometrically ; but with the precaution of augmenting the whole of the indications up to September, 1823, by two-tenths of an inch, and proceeding in the same manner with May—September of 1826, and with new barometer of June, 1829 ; all of which alterations are borne out by notes on the diary ; the results will be found to agree very well *inter se*, and to be fully sufficient for the determination of the annual and diurnal oscillations, which it is my object to deduce for as many points as possible on the Indian continent.

The following tables present an abstract of the monthly means deduced from Dr. Wylie's daily observations : they have been reduced to the temperature of 32° Farh.

Five months of 1820 are omitted for want of space, as the year was incomplete ; but the entries were used in the calculations of the monthly means in the tables which follow.

Table I.—*Meteorological Observations at Nagpúr, by* Dr. Wylie. *Barometer reduced to* 32° *Farh.*

| | 1821 | | 1822 | | 1823 | | 1826 | 1827 | 1828 | 1829 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 9 A. M. | 5 P. M. | 9 A. M. | 5 P. M. | 9 A. M. | 5 P. M. | NOON. | NOON. | NOON. | NOON. |
| January, | 28.906 | 28.783 | 28.839 | 28.722 | 29.026 | 28.927 | 28.880 | .... | 28.867 | 28.807 |
| February | 29.031 | .914 | .866 | .725 | 28.980 | .886 | .780 | .... | .752 | .796 |
| March, | .102 | .989 | .756 | .642 | .862 | .779 | .... | 28.759 | .716 | .733 |
| April, | .038 | .895 | .698 | .587 | .763 | .655 | .... | .666 | .622 | .615 |
| May, | 28.842 | .729 | .710 | .646 | .695 | .610 | .612 | .... | .562 | .... |
| June, | .695 | .611 | .667 | .593 | .682 | .568 | .481 | .402 | .427 | .390 |
| July, | .563 | .492 | .643 | .543 | .630 | .514 | .455 | .401 | .437 | .458 |
| August, | .465 | .412 | .646 | .560 | .693 | .610 | .507 | .478 | .512 | .508 |
| Sept. | .558 | .472 | .706 | .613 | .803 | .680 | .547 | .515 | .515 | .556† |
| October, | .733 | .634 | .828 | .724 | | | .724 | .711 | .688 | .675† |
| Nov. | .805 | .760 | .970 | .859 | | | .844 | .811 | .841 | .845† |
| Dec. | .889 | .770 | 29.012 | .922 | | | | .... | .847 | .847† |

† 0.200 has been added to these five months as supposed index error of a new tube then used.

* After this filling of the tube in the *damp weather* of June, we find the mercury for five months standing full two-tenths too low, confirming my remarks in a former number of the Journal. The cleaning in the dry weather of November again raised the index to the same or even a greater amount.

Table II.—*Thermometer in doors, attached to the Barometer.*

| | 1821 | | 1822 | | 1823 | | 1826 | 1827 | 1828 | 1829 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 9 A. M. | 5 P. M. | 9 A. M. | 5 P. M. | 9 A. M. | 5 P. M. | NOON. | NOON. | NOON. | NOON. |
| January, | 72.9 | 78.7 | 71.3 | 76.3 | 74.7 | 78.0 | 74 | .... | 71 | 72 |
| February | 76.0 | 82.3 | 75.0 | 82.4 | 77.0 | 82.0 | 78 | .... | 76 | 72.5 |
| March, | 81.0 | 84.0 | 82.8 | 88.2 | 80.3 | 84.5 | .... | 83 | 81.5 | 83 |
| April, | 87.7 | 90.7 | 86.0 | 88.3 | 88.0 | 91.0 | .... | 84 | 83 | 85.5 |
| May, | 87.8 | 91.0 | 91.5 | 93.2 | 88.8 | 88.6 | 82.5 | .... | 84 | .... |
| June, | 89.0 | 91.3 | 87.0 | 90.1 | 88.5 | 89.4 | 88.7 | 89 | 86 | .... |
| July, | 81.9 | 84.7 | 83.1 | 84.9 | 84.2 | 86.2 | | 85 | 83 | 81.5 |
| August, | 80.9 | 83.5 | 82.6 | 84.0 | 82.9 | 84.3 | | 81 | 83 | 81 |
| Sept. | 81.0 | 83.4 | 82.0 | 83.2 | 83.0 | 83.7 | | 82 | 82 | 82 |
| October, | 77.7 | 83.5 | 83.0 | 86.0 | .... | .... | | 83.5 | 81 | 82 |
| Nov. | 75.5 | 79.9 | 76.8 | 81.3 | .... | .... | | 76 | 76 | 75.5 |
| Dec. | 66.7 | 74.0 | 72.8 | 76.6 | .... | .... | | 73 | 71 | 72.5 |
| Means. | 79.8 | 84.0 | 81.1 | 84.5 | | | 80.9 | | 79.8 | 78.7 |

Table III.—*Fall of Rain at Nagpúr, registered by* Dr. Wylie.

| Month. | (Lloyd) 1814-15 | 1826 | 1827 | 1828 | 1829 | 1830 | 1831 | 1832 |
|---|---|---|---|---|---|---|---|---|
| January, | .. | 2.30 | 0.40 | 0.19 | .. | .. | .. | .. |
| February, | .. | .. | 0.50 | 1.21 | 0.76 | .. | .. | 2.98 |
| March, | .. | .. | 3.84 | 0.71 | 2.49 | 1.57 | .. | .. |
| April, | .. | .. | 1.01 | 0.06 | 0.06 | 0.68 | .. | .. |
| May, | .. | 1.10 | 0.21 | 1.55 | .. | 1.35 | .. | .. |
| June, | 0.23 | 22.23 | 6.25 | 8.37 | 8.07 | 8.54 | 13.78 | 8.01 |
| July, | 7.08 | 12.00 | 14.93 | 9.33 | 15.94 | 7.10 | 7.22 | 14.49 |
| August, | 14.72 | 18.50 | 7.51 | 9.07 | 7.89 | 7.00 | 14.58 | 3.46 |
| September, | 7.36 | 8.13 | 16.32 | 9.40 | 6.32 | 4.78 | 11.98 | 7.77 |
| October, | 2.97 | 0.04 | 0.00 | 6.46 | 8.22 | 1.98 | 7.24 | ... |
| November, | 0.45 | 1.31 | 2.89 | 0.26 | .. | .. | 2.27 | .. |
| December, | .. | .. | 0.13 | .. | 0.50 | .. | 8.24 | .. |
| Annual, Total, | 32.81 | 65.61 | 53.99 | 46.61 | 50.25 | 33.00 | 65.31 | 37.14 |
| In the Monsoon, | 32.36 | 62.00 | 45.22 | 44.18 | 46.44 | 30.75 | 54.80 | 33.73 |

Average of eight years, ................ 48.10 inches.

From these data we may proceed to calculate the annual and diurnal ranges, according to the form adopted in my former tables in the first volume of this Journal, page 23. The Latitude of Nagpúr is about 21° 10′ N. and the Longitude 79° 15′ E., the Barometer therefore should have a smaller rise and fall, during the year, than that of Calcutta, but greater than that of Madras, and so it turns out. There should also be a corresponding modification in the annual range of temperature, and in the diurnal change of heat and pressure: but I must leave any general deductions until I have accumulated other tables, to place in comparison with those already collected. A very accurate annual series has been kept at Cuttack by Captain B. Blake, which I trust will shortly appear in the Journal.

*Average Range of the Barometer at Nagpúr, reduced to 32° Farh.*

| Month. | For the years 1820-23. 9 A. M. | 5 P. M. | Mean. | For the years 1826 to 1829, at about 1 P. M. | Monthly difference from annual mean. | Mean Diurnal Barometric Tide, 1820-23. | Prevailing winds. |
|---|---|---|---|---|---|---|---|
| | inch. | inch. | inch. | inch. | inch. | inch. | |
| January, .. | 28.926 | .810 | 28.868 | 28.851 | +.162 | .116 | E. |
| February, .. | .959 | .845 | .902 | .776 | +.142 | .114 | var. |
| March, .. | .906 | .803 | .854 | .736 | +.098 | .103 | var. |
| April, .... | .833 | .712 | .772 | .634 | +.008 | .121 | Wy. |
| May, .. .. | .749 | .662 | .705 | .587 | —.051 | .077 | W. |
| June, .. .. | .637 | .539 | .588 | .425 | —.191 | .098 | W. |
| July, .. .. | .576 | .486 | .531 | .438 | —.213 | .090 | W. |
| August, .. | .587 | .507 | .547 | .501 | —.173 | .080 | W. |
| September, | .674 | .575 | .625 | .533 | —.118 | .099 | W. |
| October, .. | .796 | .683 | .739 | .699 | +.022 | .113 | Ny. |
| November,. | .887 | .809 | .848 | .835 | +.144 | .078 | NE. |
| December,. | .950 | .846 | .898 | .847 | +.175 | .104 | var. |
| Means,.... | 28.790 | 28.689 | 28.739 | 28.657 | Range .388 | .100 | |

In lieu of taking the thermometric means from Dr. Wylie's Tables, which are only entered for the hours at which the barometer was registered, the following extracts from a Journal kept by Captain Lloyd, for which also we are indebted to Dr. Wylie, will better serve to furnish the range of the daily temperature.

*Thermometric Range at Nagpúr, by Captain Lloyd.*

| Month. | 1809. max. | min. | mean. | 1814-15. max. | min. | mean. | Monthly difference from annual mean. | Mean diurnal range. |
|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | ° | ° | ° | ° | ° |
| January, .. | 78 | 69 | 68 | 83,8 | 57,5 | 71,0 | —11,4 | 17,1 |
| February, .. | 87 | 72 | 75 | 87,1 | 63,3 | 73,9 | — 6,5 | 19,4 |
| March, .. | 98 | 64 | 83 | 98,9 | 69,0 | 85,2 | + 3,1 | 31,9 |
| April,.. .. | 100 | 77 | 89 | 102,5 | 81,3 | 93,0 | +10,5 | 21,6 |
| May, .. .. | 101 | 79 | 90 | 104,4 | 91,6 | 98,4 | +13,3 | 18,4 |
| June, .. .. | 91 | 76 | 84 | 103,6 | 85,6 | 90,3 | + 6,2 | 16,0 |
| July, .. .. | 88 | 74 | 79 | 86,9 | 78,4 | 82,5 | — 0,2 | 10,8 |
| August, .. | 86 | 70 | 79 | 88,9 | 77,3 | 82,7 | — 0,1 | 13,8 |
| September, | 85 | 75 | 79 | 91,9 | 78,2 | 84,3 | + 0,7 | 11,8 |
| October, .. | 88 | 64 | 79 | 89,3 | 74,4 | 83,1 | + 0,1 | 19,4 |
| November,. | 86 | 54 | 73 | 87,8 | 60,9 | 75,3 | — 6,8 | 24,4 |
| December,. | 85 | 57 | 72 | 84,9 | 60,6 | 72,6 | — 8,6 | 26,1 |
| Mean, .... | 89.4 | 69.3 | 79.2 | 92,5 | 73,5 | 82,7 | Range 24,6 | 19,2 |

The constant difference between the numbers of the two years leads me to attribute it to an index error of one of the thermometers. Probably the second instrument stands too high, for the other more nearly agrees with those of Drs. Wylie and Geddes. A want of prior comparison with a standard instrument thus often destroys confidence and robs of half its value the labour of years. Such an error however does not interfere with the results derived from this table, namely, the monthly and diurnal range:—it only affects the mean annual temperature, which, with all the data before us, cannot positively be determined, although the numerous observations of different hours and with different instruments may neutralize many irregularities: thus we have the mean annual temperature,

| | | |
|---|---|---|
| At Sunrise, in the open air.. | 69,5 | from Dr. Geddes' Tables (page 241.) |
| Minimum temperature, .. .. | 69,3 | by Captain Lloyd. |
| At nine A. M. in the house,.. | 80,5 | by Dr. Wylie. |
| At noon ditto, .... ........ | 80,3 | (tatty used in the hot months?) |
| At two P. M. ditto, .... .... | 81,1 | by Dr. Geddes. |
| Maximum temperature, .... | 89,4 | by Captain Lloyd. |
| At five P. M. ditto, .... .... | 84,2 | by Dr. Wylie. |
| At eight P. M. ditto,........ | 80,2 | by Dr. Geddes. |
| Mean of maxima and manima, | $\left\{ \begin{matrix} 79{,}2 \\ 82{,}7 \end{matrix} \right\}$ | by Captain Lloyd. |

From the mean of the maxima and minima, and from the pair of observations at 9 A. M. and 8 P. M., it may be assumed with tolerable confidence that the mean temperature of Nagpúr does not differ much from 80° Farh. which is nearly two degrees higher than that of Calcutta, and $1\frac{1}{2}$ lower than that of Madras.

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## VI.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 30th October,* 1833.

The Honorable Sir Charles Theophilus Metcalfe, Bt. V. P. in the Chair.

The Proceedings of the last meeting were read.

*Read,* a letter from Colonel Casement, Military Secretary, stating that the Government will have much pleasure in transmitting to the Honorable the Court of Directors the Report on the Experimental Boring, and in recommending a compliance with the Society's application for such a supply of apparatus as will enable them to continue it in an efficient manner.

*Read,* a letter from G. A. Bushby, Esq. Sec. Gen. Dep. communicating the permission of Government for the dispatch of 100 copies of the 18th volume of the Researches by the first ships of the season, free of charge for freight.

*Read,* a letter from W. Twining, Esq. Secretary to the Medical and Physical Society, expressing their regret at being unable to pay a monthly contribution for the use of the rooms occupied by their Library and Museum, and repeating the acknowledgment of the President and Members for the liberality which has afforded them that accommodation.

*Read,* a letter from J. C. Morris, Esq. Secretary Mad. Lit. Soc. requesting the loan of a volume of the Mackenzie MS. Translations of Inscriptions in the South of India. *Resolved,* that the request be immediately complied with.

*Read,* a letter from the Rev. Dr. Burrow, forwarding the printed prospectus of a plan for an expedition into Central Africa, and requesting the encouragement and assistance of the Physical Class of the As. Soc.

*Resolved,* that the funds of the Society are not in a state to allow a contribution towards the objects of the African expedition, but that the aid of individuals be invited by circulation of the prospectus amongst the members*.

*Library.*

The following books were presented:

Third part of the sixteenth volume of the Transactions of the Linnæan Society, together with a list of its members, for 1832—*by the Society.*

Transactions of the American Philosophical Society, part 2nd, vol. 4th, new series—*by the Society.*

Memoirs of the Astronomical Society of London, vol. 5th—*by the Society.*

Report of the First and Second Meetings of the British Association for the advancement of Science—*by the Yorkshire Philosophical Society.*

Proceedings of the Natural History Society of the Mauritius, for June, 1833—*by the Society.*

Proceedings of the Geological Society of London, No. 28—*by the Society.*

Madras Journal of Literature and Science—*by the Madras Literary Society.*

Journal Asiatique, Nos. 58, 62, and 63—*by the Asiatic Society of Paris.*

Thirteenth and fourteenth volumes of the Transactions of the Batavian Society—*by the Society.*

Second Annual Report of the Council of the Naval and Military Library and Museum—*by Messrs. Bagshaw and Co. for the Council.*

Von Hammer's History of the Ottoman Empire, 9th volume, and some loose tracts—*by the Author.*

Jahrbucher der Literature, vols. 57, 58, 59, and 60—*by Councellor Von Hammer.*

Marcoz, Astronomie Solaire Simplifiee—*by H. T. Colebrooke, Esq.*

De Tassy, Memoire sur le Systeme Metrique des Arabes—*by the Author,*

Leipziger Literature Zeitung, Nos. 206, 207, 208, and 209—*by the Editor.*

D. H. Fitton on the Progress of Geology in England—*by the Author.*

Ditto's Geological Sketch of the Vicinity of Hastings—*by the Author.*

A short system of Polite Learning, compiled and translated by Maha Raja Kalí Kissen Bahadur—*by the Translator.*

Select Extracts from Lord Chesterfield's Advice to his Son, translated into Bengalee, by Radhanath Dey—*by the Translator.*

Stocqueler's Fifteen Months' Pilgrimage through untrodden tracts of Khuzistan and Persia—*by the Author.*

The following books were received from the Book-sellers:

Lardner's Cabinet Cyclopedia—British Admirals, 1st vol.
Iron and Steel, 2nd vol.
Christian Church, 1st vol.

Library of Useful Knowledge—Waddington's History of the Church.
Spain and Portugal.

* Printed on the cover of the present number.

Lyell's Principles of Geology, 3rd vol.

Theatrum Pontificiale, 5 vols.—*purchased by the Society.*

Memoires Concernant les Chinois, 14 vols.—*presented by the Secretary.*

*Read,* a letter from Mr. A. Boue', Foreign Sec. of the Geological Society of France, offering an exchange of their publications against the Journal and Transactions of the As. Soc. *Resolved,* that the exchange be made with pleasure, through the Society's Agent in London.

*Read,* also letters from Professor Von Hammer, the Secretaries of the Philadelphian and Batavian Societies, &c. relative to the works detailed above.

*Antiquities, Statistics, &c.*

*Read,* a letter from Mr. Tufnel, Sec. of the Right Honorable the Governor of Ceylon, presenting copies of some inscriptions in the Nágarí character, collected by Captain Forbes of the 78th Highlanders, agent in the Matele district.

Thousands of inscriptions, in the same character, are stated to be found in the island: but we have not yet any clue to the relative value of these letters in the modern Nágarí alphabet. They are evidently identical with those of the Kanouj coins* and with the inscriptions referred by Mr. Stirling to the Buddhists, or Jyns; which their occurrence in Ceylon certainly tends to confirm.

*Read,* a letter from E. Stirling, Esq. submitting a tabular statement of the price of grain at Alligurh, from our first possession of the country, to 1832.

A statistical report on the population of the town and district of Múrshedabad, drawn up by Mr. H. V. Hathorn, was submitted by Mr. J. R. Colvin.

[We shall give an abstract of these statements in our next.]

*Read,* a note from Mr. J. H. Stocqueler, presenting some coins, collected during his travels in Europe.

A Fac Simile of an Arabic Inscription, cut in an escarpment of the rock at the Fort of Chanderí, was presented by Dr. J. Tytler, in the name of Lieut. Macdonald; from whose letter, the following extract was read:

"I have discovered an ancient inscription at Chanderí, near which I am now encamped. This place now belongs to Scindia, who took it from the former Raja, 20 years ago. The Fort of Chanderí, which consists of a sandstone wall, flanked by circular towers, built upon a steep hill, was in former days considered impregnable. Colonel Baptista, of Scindia's service, succeeded after a five months siege in starving out the Bundela garrison, and it is now occupied by Marhatta troops. To my inquiries into the ancient history of the place, I could obtain no satisfactory information. The ignorant Marhattas and Bundelas could only name one famous Raja, Sisupal, who flourished in the days of Hindu supremacy, and founded this place. It was afterwards rendered famous by being the residence of Alemgir for a short period. The ruins of mosques, saraís, madrissas, and baolies, mahals and zenánas, indicate its former magnificence under the Musulman sovereignty. There are many ancient inscriptions, but I selected the accompanying, which I found upon a famous ghât or passage which has been cut with stupendous labour

* See page 415 and p. 317.

through a sold rock 100 feet high. This ghât which leads from Chanderí through a sandstone ridge into the adjacent country is in itself a lasting monument of the gigantic undertakings of the Musulman sovereigns, but to the modern inhabitants even the name of the monarch who accomplished this great excavation is unknown. I hope therefore that this inscription will rescue it from oblivion.

" The inhabitants of this country view our trigonometrical operations with suspicion and dread. They cannot comprehend the object of burning lights upon the summits of distant hills, and they can only atribute it to some black art, or *jadu*, by which we wish to take possession of their country. " The weather is getting hot, the thermometer ranging between 88° at sunrise, and 108° at 2 P. M. in my tent.

18*th May*, 1833, *Camp near Chanderí.*

The inscription, after insertion of the second *Sura* of the Korán, called *Ayet-ul-Kursí*, sets forth that the lofty gate of Gumtí and Kerolí, near the tank, were erected by Júman Khán, son of Shér Khán, by order of the Sultán-us-Salatín Ghias-ud-din, on the 14th *Jumád-us Sáni* A. H. 700 (A. D. 1301).

*Physical.*

Letters from Lieut. Burt, Engineer, of Allahabad, dated 26th August, and from Lieut. Newbolt, of Malacca, 11th July, were read, intimating that they had dispatched shells and geological specimens, which have not yet reached their destination.

Specimens of coal, lignite, pyrites, &c. from Kyook Phyoo, were presented in the name of Lieut. Foley.

[A note on the subject of Lieut. Foley's discoveries will appear in our next.]

Specimens of the fossil shells discovered by Dr. H. H. Spry, Corresponding Member, Ph. Cl. in digging a well near Ságar.

These are the specimens alluded to in a notice published in the July number of the Journal (page 376), announcing the discovery of fossil shells, 17 feet below the surface. Dr. Spry's account has not been yet received, it may suffice therefore to state that the shells are of one species, all left-handed, and precisely the same as those discovered by Dr. Spilsbury, silicified in indurated clay, near Jabalpur, and described in the Proceedings of the Society for April, (p. 205) ; these however are in their natural state, imbedded in a loose cellular wacken, the white granular appearance of which is derived from silex in a white crumbling state, lining the numerous cells of the matrix as is often observed in the geodes of zeolite and heliotrope. Both above and below the shell stratum are beds of wacken, a basaltic clay, becoming harder below, and more earthy above ; the surface being the common black cotton soil, abounding throughout the trap district. The same shell deposit will probably be found to extend over a considerable field.

On turning to Dr. Voysey's description of the shell stratum in the Gáwilgarh hills, a perfect identity is observable in the thickness and nature of the superincumbent and subjacent beds of wacken and basalt : the shells however are described by him as conus or voluta, but as they were much broken and compressed, they were probably not easily recognized, and may have been after all identical with the present shells. They bear some resemblance to the common *ampullaria* of the tanks and jheels of Upper India, described by Mr. Benson, Gleanings, i. p. 265. The fossil shell however has some specific distinctions, in its more oval form, and the constant reversion of the whorls. Should it turn out to be an *ampullaria*, it will be a proof of fresh water lakes, co-existent with the emission of the Upper Ságar trap, and perhaps with the fossil bone deposit, and as both by Voysey's testimony and by that of Dr. Spry the shell bed bears all the appearance of a regular stratum—it will serve as a mark of distinction between the older and more recent volcanic emissions of that extensive field.

Further specimens of fossil bones and of shell breccia, and the fossil jaw of an elephant; also specimens of the rock on which the bones were discovered, near Jabalpúr, by Dr. Spilsbury. [A note and illustrative section will be given in our next.]

A stuffed eagle from Nipal, and a pole-cat, presented by Captain Roxburgh.

Two specimens of the nest of the Tailor bird—by S. P. Stacy, Esq.

A report from the Curator was submitted on the subject of a collection of insects and shells, which had been purchased in anticipation of the Society's sanction, for the Museum, at an expence of Rupees 100. The collection was made in the Silhet and Kasya hills, and contains several new species, particularly one of a *paludina*, first described by Mr. Benson, in the first number of the Journal. A paper on the subject of this shell, by Dr. J. T. Pearson, was read, and the purchase of the collection was sanctioned.

The thanks of the Society were voted for the several contributions of the evening.

## MADRAS LITERARY SOCIETY AND AUXILIARY OF THE ROYAL ASIATIC SOCIETY.

*Thursday, 8th August*, 1833.

The Right Honorable Sir F. Adam, K. C. B. Present. Honorable Sir R. Palmer, President, in the Chair.

An able and interesting paper on the rise and early history of the Syrian Christians on the Malabar Coast, by the Venerable the Archdeacon, was read to the meeting by the learned author, to whom the thanks of the Society were unanimously voted. It was further resolved, that the paper in question be adopted by the Society and be set aside for publication.

It was then proposed by Lieut.-Col. Coombs and seconded by Lieut.-Col. Cullen.

That it is desirable with reference to several interesting memoirs and papers which have already been submitted to the Society, and to others which may hereafter be received, to adopt means for giving them earlier publicity than the necessarily distant and slow publication of the Society's transactions will admit; and, that independently of papers read before the Society, and of notices of their meetings and proceedings, the publication under the auspices of the Society of a monthly or quarterly journal, similar to the Asiatic Journal of Calcutta, would, by affording a suitable vehicle for occasional essays and papers connected with objects of oriental literature and science be in strict furtherance of the professed object of the Society, and likely to prove if adequately supported and encouraged, eminently and extremely useful.

The foregoing resolution having been discussed, was agreed to, and it was resolved to refer the same to the Committee of Papers in the Asiatic Department, to arrange the details and adopt the necessary measures for carrying the plan into effect. Several works were presented and thanks voted for the same.

## VII.—Analysis of Books.

*Seventeenth volume of* Asiatic Researches, *or Transactions of the Society instituted in Bengal for inquiring into the History, the Antiquities, the Arts and Sciences and Literature of Asia. Calcutta,* 1832.

This volume is prefaced with an address from the Society to its late Secretary Mr. H. H. Wilson, upon the occasion of his departure to Europe, which will be found printed at length in the Journal, vol. i. p. 563.

I. The first paper is a *Statistical Report on the Bhotia Mehals of Kemaon, by G. W. Traill, Esq. Commissioner.* It forms a supplement to the more elaborate report by the same officer on the district of Kemaon, printed in the sixteenth volume of the Asiatic Researches, 1828.

The Bhot Mehals, forming in extent one-third of the Kemaon province, are bounded at the north by the table-land of Tibet, on the south they extend to the base of the Himálaya range, and are irregularly defined, piercing through the barrier of the snowy range at the passes of the five principal rivers, *Mana* and *Níti*, on the feeders of the *Ganges; Juwar, Darma,* and *Byanse,* on those of the *Sarda* or *Gogra.*

These limited valleys, or gorges, are the only productive and inhabitable parts of Bhot, the rest consisting of snow and barren rock. They are elevated 6000 feet above the sea, while the peaks around them tower to 20 and 25,000 feet. The Bhotias insist that the zone of snow is continually extending, and cutting off passes from one valley to another, which were formerly passable at least for a few days in the year. The only accessible roads now follow the direction of the streams, and owing to avalanches (*húin gul*) and slips (*paira*) require constant toil for their preservation. The *Níti* is the most practicable pass, but at many points ponies and cattle are forced to be raised or lowered by means of slings passed round their bodies !

There are but 59 villages and 1325 houses, and about 10,000 inhabitants in this mountainous district, of whom nine-tenths are Bhotias or Tibetans.

For half the year the ground is covered with snow, and an interval of four months without a fall of snow, forms an uncommonly favorable summer !

*Phapar* and *Ugal,* two varieties of buck-wheat, *Uä Jao* and *Jao,* beardless and common barley, are the principal agricultural products of the province. The *Phaper* seem indigenous, as it is found wild on all high mountains. Wheat and *Marsa,* a species of Amaranthus, yield an uncertain crop.

" Turnips and leaks are the only vegetables raised in Bhot ! but many useful roots and herbs are spontaneously produced, among these are, the wild garlic, celery, rhubarb, frankincense (*mari* or *balchar*), *laljari, chora, bhotkes,* and *kathi,* objects of export to Hindustan. The rhubarb is somewhat inferior in its color and properties to the Turkey, and the Bhotias do not take it inwardly, though they apply the powder to wounds and bruises : it is also used as an ingredient in the formation of a red dye, in conjunction with *Manjith* (very abundant here) and potash."

Among the fruits, Mr. Traill enumerates the gooseberry, currant, raspberry, strawberry, and pear. Walnuts and hazlenuts are common, but small ; apricots and peaches do not thrive. Oaks, pines, the celebrated *Deodar,* and the *Suryi* or Arbor vitæ, with trunks of 20 and 25 feet in circumference, are common ; to them succeed the Rhododendron, the king pine, the yew, the *Naspati,* or white Rhododendron, (used as snuff,) *Bindhara* or juniper, and above all, the *Bhoj* (*bhuria*), or birch on the very verge of perpetual snow*.

* See note in page 337.

The domestic animals are the common hill black cattle, and the *Surágai* or *Yák* of Tartary ; the *Jábu* and *Garju* are prolific mules between these two, very serviceable for carriage : sheep and goats, used also for burden ; stout ponies, called *Gunts*, dogs, (the *Buansu*, tamed,) and cats. The wild animals are the *Barjí* or tawny bear ; the *Bharal*, wild sheep ; *Kasturi*, musk deer ; the *Bhia*, a small brown marmot ; the *Kukar*, ferret, and rats with short tails.

The birds peculiar to *Bhot* are the falcon and hawk, the *Hiún-wál* (bird of snow), ptarmigan ; *Múkao*, wild pigeon, and *Kyang*, or chough, with scarlet bill and legs. The *Bhaunr* or wild bee builds its nest on the southern aspect of the Himálaya.

Of minerals, Mr. Traill mentions iron, sulphur, and yellow orpiment. The fossil bones called *Bijlí hár* are chiefly found at the crest of the *Niti* pass, full 17,000 feet high. Hot springs are numerous, and there is reason to suspect that a volcano exists on the *Nanda Deví* peak.

We have not space to follow the author into the history and manners of the people who inhabit this secluded tract : they derive their origin from Tibet but shew an equal admixture of Hindú in their institutions. It would have been interesting to have added a vocabulary of words in the unwritten *Darma* dialect spoken by the aborigines of the country.

Situated between the Tibetan and Gorkha powers, the Bhots have had to pay for the protection of both : and being the key of commercial intercourse between Tartary and Hindustan, the revenue *jama*, raised from this limited population, on the introduction of the British Government, in 1872, *Sambat*, amounted to so large a sum as Rupees 11,565. By an enlightened policy, the transit duties were soon after all abolished, and though the direct receipts were thus reduced to one-half, the increase of trade must have amply compensated for the loss.

The principal exports from *Bhotia* to *Tibet* or *Hiundés* (snowland) consists of grain, calico, hardware, broadcloth, gúr, sugar, and timber. The imports are salt, the natural produce of lakes in *Hiundés*, 15,000 maunds : *tincal* or *borax*, also the natural produce of a lake ; in this article there was much speculation for the British market, and the import increased from 1500 to 20,000 maunds in 1818-19, a quantity far exceeding the demand in England. The supply has since fallen to 7 or 8000 mds. The other imports are wool, shawl-wool, gold dust, and a few trifling articles. As the imports from 1816 to 1821 much exceeded the exports, a large amount of Furukhabad rupees found their way to *Hiundés*, of which they have become the favorite currency.

Mr. Traill's able report terminates with a few remarks on the province of *Hiundés*, of which a full account has already been given in the Journal in Mr. A. Csoma's Geographical Notice of Tibet, (vol. i. p. 124.)

II.—The next paper is an *Essay on the mode of performing the arithmetical operation of the extraction of roots, as practised by the Arabs, and given in the Ayoun-ool-Hisab, by John Tytler*. At first sight this paper appears rather lengthy, but its subject is one which it is difficult to compress so as to render intelligible, and indeed without a diagram it is by no means easy to render it intelligible at all.

The Binomial formula of any power $(a+b)^n$ is $a^n + n\,a^{n-1}b + \frac{n.\,n-1}{2}\,a^{n-2}b^2$ &c. . . . . . . $b^n$. This may be considered as consisting of two terms $a^n$ and $n\,a^{n-1}\,b + \frac{n.\,n-1}{2}\,a^{n-2}\,b^2 \;\ldots\; b^n$. Supposing a given number to consist of more than $n$ figures, and consequently to be of the form $e\times10^n+r$ then if $u^n$ be the nearest approximate $n^{th}$ power to $e$ and if $e\times10^n-u^n\times10^n=v$ and $u^n\times10^n$ be supposed to expound $a^n$ and $v+r$ to expound $n\,a^{n-1}\,b+\frac{n.\,n-1}{2}$ $a^{n-2}\,b^2\ldots\ldots b^n$, the complete $n$th root of $e\times10^n+r$ will be found by finding an approximate $n$th power to $e$, and then seeking such a number as when substituted for $b$ in $na^{n-1}\,b+\frac{n.\,n-1}{2}\,a^{n-2}\,b^2\ \ldots.\ b^n$ will render the sum of this expression and the product of the nearest $n$th power already found into $10^n$, less or not greater than $e\times10^n+r$ or $(a+b)^n$. And this operation is to be repeated according to the number of figures in $(a+b)^n$.

Our books of arithmetic contain nothing farther than the above statement, and leave the mode of finding the second number of the root, and of its successive involutions and multiplications into its proper co-efficients, entirely to the student. The Arabian arithmeticians, with a good deal of ingenuity certainly, (whether well or ill directed is another question,) have invented a table or diagram in which, by a sort of mechanical process, the sought number $b$ by the bare process of multiplication into one figure, and addition to the number above it, is successively involved to all its powers, multiplied into all its co-efficients, and the sum of the whole found.

The Arabians give to their diagram the quaint name of *Shukul-i-Mumburee,* or Pulpit, or, as Mr. Tytler more grandly translates it, Anabathroidal diagram. The figure consists of ascending steps like those of the stairs of a Mohammadan pulpit. The etymologies of by far the greater part of our technical terms are not more rational.

The Arabian operation, in fact, is a very careful mode of finding the result of $n\,a^{n-1}\,b+\frac{n.\,n-1}{2}\,a^{n-2}\,b\ldots.\ b^n$ so as not to repeat any of the steps or perform the same calculation twice over. With our present improved methods, it is seldom that the arithmetical extraction of roots of high powers is performed; but were it often required, we should soon find the necessity of attention to this matter, and of some system in arranging our operations, so as to avoid doing the same thing over and over again.

Such mechanical contrivances have been employed by the greatest Mathematicians: it will be sufficient to instance the celebrated square, almost on the principles of a magic square, invented by Sir I. Newton, for solving equations by means of converging series. A mind curious in tracing analogies, might discover in the Arabic anabathroidal diagram, some traces of that reasoning which must have led to the discovery of the wonderful calculating machine of Mr. Babbage.

To give an idea of the Arabian method, we shall here extract the approximate 6th root of 166,571,800, which is the two first steps of the example given by Mr. Tytler. In the original diagram longitudinal lines are drawn between each two figures: for those we have substituted dots, and the several steps of the operation are numbered I. (which is at the bottom) II. III. &c. To abbreviate, let 10 be denoted by $\phi$, 166 by $e$, 571800 by $r$, 2 the approximate 6th root of 166 by $a$ and 3 by $b$, and the effect of the several operations will be as marked in the following diagram.

| | | |
|---|---|---|
| | 2 | |
| | 166 | $= e$ |
| VI. | .64 | $= \text{V} \times a = a^6$ or 6th power of approximate root of $e$ or first Subtrahend. |
| | ——3 | |
| VII. | 102571800 | $= (e - a)\,\phi^6 + r =$ Resolvend. |
| XLVI. | ..84035889 | $= \text{XLV} \times 3 = 6\,a^5\,\phi^5\,b + 15\,a^4\,\phi^4\,b^2 + 20\,a^3\,\phi^3\,b^3 + 15\,a^2\,\phi^2\,b^4 + 6\,a\,\phi\,b^5 + b^6$ or second Subtrahend. |
| XLV. | .28011963 | $= \text{XLIV} + \text{XVII} = 6\,a^5\,\phi^5 + 15\,a^4\phi^4\,b + 20\,a^3\,\phi^3\,b^2 + 15\,a^2\,\phi^2\,b^3 + 6\,a\,\phi\,b^4 + b^5$. |
| XLIV. | ..8811963 | $= \text{XLIII} \times 3 = 15\,a^4\,\phi^4\,b + 20\,a^3\,\phi^3\,b^2 + 15\,a^2\,\phi^2\,b^3 + 6\,a\,\phi\,b^4 + b^5$. |
| * XVII. | . 192..... | $= \text{XVI} \times \phi^5 = 6\,a^5\,\phi^5$. |
| XVI. | 192...... | $= \text{XV} + \text{V} = 6\,a^5$. |
| XV. | 160...... | $= \text{XIV} \times a = 5\,a^5$. |
| V. | . 32...... | $= \text{IV} \times a = a^5$. |
| XLIII. | ..2937321 | $= \text{XLII} + \text{XXV} = 15\,a^4\,\phi^4 + 20\,a^3\,\phi^3\,b + 15\,a^2\,\phi^2 b^2 + 6\,a\,\phi\,b^3 + b^4$. |
| XLII. | ...537321 | $= \text{XLI} \times 3 = 20\,a^3\,\phi^3 b + 15\,a^2\,\phi^2\,b^2 + 6\,a\,\phi\,b^3 + b^4$ |
| * XXV. | ..240.... | $= \text{XXIV} \times \phi^4 = 15\,a^4\,\phi^4$. |
| XXIV. | 240...... | $= \text{XXIII} + \text{XIV} = 15\,a^4$. |
| XXIII. | 160...... | $= \text{XXII} \times a = 10\,a^4$. |
| XIV. | . 80...... | $= \text{XIII} + \text{IV} = 5\,a^4$. |
| XIII. | . 64...... | $= \text{XII} \times a = 4\,a^4$. |
| IV. | . 16...... | $= \text{III} \times a. = a^4$ |
| XLI. | ...179107 | $= \text{XL} + \text{XXXI} = 20\,a^3\,\phi^3 + 15\,a^2\,\phi^2\,b + 6\,a\,\phi\,b^2 + b^3$ |
| XL. | ....19107 | $= \text{XXXIX} \times 3 = 15\,a^2\,\phi^2\,b + 6\,a\,\phi\,b^2 + b^3$. |
| * XXXI. | ...160... | $= \text{XXX} \times \phi^3 = 20\,a^3\,\phi^3$. |
| XXX. | 160...... | $= \text{XXIX} + \text{XXII} = 20\,a^3$. |
| XXIX. | .80...... | $= \text{XXVIII} \times a = 10\,a^3$. |
| XXII. | .80...... | $= \text{XXI} + \text{XII} = 10\,a^3$. |
| XXI. | . 48...... | $= \text{XX} \times a = 6\,a^3$. |
| XII. | .32...... | $= \text{XI} + \text{III} = 4\,a^3$. |
| XI. | . 24...... | $= \text{X} \times a = 3\,a^3$. |
| III. | ..8...... | $= \text{II} \times a = a^3$. |
| XXXIX. | .....6369 | $= \text{XXXVIII} + \text{XXXV} = 15\,a^2\,\phi^2 + 6\,a\,\phi\,b + b^2$. |
| XXXVIII. | ......369 | $= \text{XXXVII} \times b = 6\,a\,\phi\,b + b^2$. |
| * XXXV. | .....60.. | $= \text{XXXIV} \times \phi^2 = 15\,a^2\,\phi^2$. |
| XXXIV. | .60...... | $= \text{XXXIII} + \text{XXVIII} = 15\,a^2$. |
| XXXIII. | .20...... | $= \text{XXXII} \times a = 5\,a^2$. |
| XXVIII. | .40...... | $= \text{XXVII} + \text{XX} = 10\,a^2$. |
| XXVII. | . 16...... | $= \text{XXVI} \times a = 4\,a^2$. |
| XX. | . 24...... | $= \text{XIX} + \text{X} = 6\,a^2$. |
| XIX. | . 12...... | $= \text{XVIII} \times a = 3\,a^2$. |
| X. | . 12...... | $= \text{IX} + \text{II} = 3\,a^2$. |
| IX. | ..8...... | $= \text{VIII} \times a = 2\,a^2$. |
| II. | ..4...... | $= \text{I} \times \text{I} = a \times a = a^2$. |
| * XXXVII. | ......123 | $= \text{XXXVI} \times \phi + 3 = 6\,a\,\phi + b$. |
| XXXVI. | . 12...... | $= \text{XXXII} + a = 6\,a$. |
| XXXII. | . 10...... | $= \text{XXVI} + a = 5\,a$. |
| XXVI. | ..8...... | $= \text{XVIII} + a = 4\,a$. |
| XVIII. | ..6...... | $= \text{VIII} + a = 3\,a$. |
| VIII | ..4...... | $= \text{I} + \text{I}$ or $a + a = 2\,a$. |
| I. | ..2...... | $= a$ or approximate root of $e$. |

The only parts that require explanation are those steps of the operation marked with an asterisk. In these it is to be remembered, that if there be a given row of figures as 8811963, and there be added to, or subtracted from it, another row, so that the units of the second may be under the figure in the $n^{th}$ place of the first, the tens of the second under the $(n+1)^{th}$ place of the first, the hundreds under place $n+2$ &c. this is in reality adding or subtracting the product of the second row by $10^{n-1}$. Thus

$$\begin{array}{r} 8811963 \\ 192\phantom{0} \\ \hline 8813883 \end{array} \text{ is in reality } 8811963 + 192 \times 10.$$

$$\text{Again } \begin{array}{r} 8811963 \\ 192\phantom{00} \\ \hline 8831163 \end{array} = 8811963 + 192 \times 10^2$$

$$\text{and so on to } \begin{array}{r} 8811963 \\ 192\phantom{00000} \\ \hline 28011963 \end{array} = 8811963 + 192 \times 10^5.$$

The course of the other operations, by which the co-efficients of the Binomial Theorem are formed by successive additions of the several orders of figurate numbers, will be obvious to any one who takes the trouble of tracing them in the order of the diagram: for the mode of repeating the whole operation, so as to find roots of many figures, we must refer to the original paper: a little consideration however of the diagram already given will render that obvious also.

The method here detailed gives no more than the integral figures of the root, and the Arabs being unacquainted with decimal fractions, could go no farther. To remedy this, they employ a formula for finding a fraction, to be added to the integral part of the root, so as to give a nearer approximation.

Their formula is this; Let $m$ be the approximate $n$th root of M and $M - m^n = r$ then $\left[m + \frac{r}{(m+1)^n - m^n}\right]^n$ will be less than M and consequently $m + \frac{r}{(m+1)^n - m^n}$ is a nearer approximate $n$th root of M, as may be easily proved. In this case $r$ and $(m+1)^n - m^n$ are found by the last revolution of operations in the Anabathroidal Diagram.

This formula however is imperfect, and when applied to high powers, produces great errors: in the square it never can be greater than $\frac{1}{4}$, but in seeking, for example, the 6th root of 396, the error is more than $152\frac{4}{7}$. This imperfection the Arabians appear to have been anxious to remedy: their method is this; if in the above formula $n=2$, that is, if the root sought be the square root, then $m + \frac{r}{(m+1)^n - m^n}$ becomes $m + \frac{r}{2m+1}$ and the difference between the square of this and M may approximate to $\frac{1}{4}$. To remedy this, the Arabian arithmeticians instead of $m + \frac{r}{2m+1}$ assume the formula $m + \frac{2r}{4m+1}$ and then $M - \left(m + \frac{2r}{4m+1}\right)^2$ that is $m + r - \left(m + \frac{2r}{4m+1}\right)^2 = \frac{(4m+1)r - 4r^2}{(4m+1)^2}$.

Now this expression is either positive or negative. If positive, Mr. TYTLER shews, it never can exceed $\frac{1}{16}$; if negative, then since a negative deficiency is an excess, this shews that the assumed root is greater than the truth, and in this case the excess of its square above M will increase according to the value of $m$, and will approximate to $\frac{1}{2}$.

These results the author easily produces by the application of fluxions. The puzzle is, to understand by what reasoning the Arabians without any means of this kind, hit upon a convenient formula such as $m+\frac{2r}{4m+1}$. Though the formula, when found, appears simple, yet the difficulty of actually finding it, with their limited means, must have been very great. It was like the Druids elevating the immense blocks of Stonehenge without mechanics. Most probably it was discovered by long and laborious tentation.

The author then discusses the effects of assuming as the approximate square root the formula $m+\frac{rz}{2mz+1}$ in which $z$ is indefinite; but this, as foreign to the Arabs, we omit, and shall sum up the whole in his words—

"We may hence form some judgment how much the old arithmeticians must have been perplexed and retarded by the labour of long multiplication. We, who enjoy the benefits of the great discovery of Logarithms, can now scarcely form an estimate of the difficulties with which they had to contend from this want, and the facilities which we enjoy from their use. While, therefore, the Arabian method of extraction may inspire us with more gratitude to Lord Napier, we must not too hastily condemn it as uselessly laborious, till we can show that, without a knowledge of his discovery, we could have more happily succeeded in the facilitating and abbreviation of calculation. Should, after all these considerations, the intention of the Arabian operation be thought of little value, and the labour employed to accomplish it misused, yet the artful contrivances by which it is attained, and the skilful adaptation for this purpose of the simple principle of the variation of the signification of symbols from the variation of their situation, must, I think, in justice, always cause the Pulpit Diagram to be considered a deserving monument of Arabic ingenuity."

The Author concludes his essay—

"With an acknowledgment of my obligations to my very intelligent friend Dewan Kanh Jee of Patna; by him I was furnished with the extract of the Ayoun-ool-Hisab. His treatise of Arithmetic formerly mentioned*, and his oral explanations enabled me to comprehend the obscure and studied brevity of the Arabian Author; and from the same sources I derived those observations on the fractional part of the root which form the basis of the concluding paragraphs of the present Essay."

The treatise of Arithmetic here alluded to, and named by its author, the Khizanut-ool-Ilm, is described in vol. xiii. of the Researches, p. 466. It is a very large work, consisting of three parts: first, an account of Arabian Mathematical Science; next, of that of the Hindus, and lastly, as much of the European as the author was acquainted with. The whole, we are happy to say, is in the course of printing by the Committee of Public Instruction, and will, when complete, form an invaluable store of information respecting Oriental Mathematics.

The European part of the Khizanut-ool-Ilm consists of two sections: first, a complete translation by the Dewan of Bonnycastle's Algebra; secondly, an extract consisting of a collection of Geometrical Problems from the papers of the celebrated Tufuzzool Hosain Khaun of Delhi. This person during his life, was considered, we believe, the best Mohammadan mathematician in India, and he appears to have employed his time in translating European mathematical works into *Arabic;* after his death, which took place some years ago, Government, we are told, made strong efforts to obtain his MSS. but in consequence of legal disputes between his relations these were unsuccessful, and the fate of the papers is probably not known. It is much to be wished that they could be procured.

* See Essay on the Binomial Theorem, vol. xiii. of the Researches, p. 466. The Dewan here mentioned is since dead.

The above facts, the pains taken by Dewan KANH JEE, in translating from English, which he understood very imperfectly, and in which (as he acknowledges) he was greatly assisted by the kindness of HENRY DOUGLAS, Esq. of Patna, and his extracts from the papers of the Delhi mathematician, are strong proofs, notwithstanding the present fashionable doctrines, of the value set by Natives on translations from English works, when well chosen and judiciously executed.

TUFUZZOOL HOSAIN KHAUN's choice of *Arabic* for the vehicle of his translations is also a proof that intelligent Natives do not see the advantages of proscribing that language so clearly as we.

[*To be Continued.*]

II.—*Madras Journal of Literature and Science, published under the auspices of the Madras Literary Society and Auxiliary Royal Asiatic Society, edited by the Secretary, No.* 1, *October* 1833, *price to Subscribers* 3 *Rs. per quarter.*

We cannot but feel highly complimented by the appearance of a new periodical at Madras, professedly founded on the model of our own journal, and imitating our arrangements even to the style of the title page, the price, the number of pages, and the gratuitous conduct of the editorial department. We look upon it not as a rival but as a powerful auxiliary, and we hail it as a guarantee of the revival of the efforts of the Madras Literary Society. The publication of Researches in an occasional quarto volume at distant periods has been adduced as a bar rather than an incentive to contributions of a learned nature, while the limited sale of such works makes the printing charge fall heavy on a small Society: this has been partially felt in Calcutta; and it has led at Bombay, as at Madras, to the absorption of the institutions there into branches of the Royal Association at home. Under the new system however of giving rapid publication, free of cost, to short interesting and ephemeral papers (in which the Bombay Geographical Society may also easily join by a similar journal for the west of India), the independence and orientality of each might still be assured; while by a combination of the means and labours of the three Indian Societies, a volume of Researches might simultaneously be kept in hand at Calcutta for their more erudite and lengthened communications. We have not room to notice the contents of the Madras Journal at present, but we shall not scruple to extract matter that will be interesting to our own readers. We sincerely regret the untimely end of Lieut.-Colonel COOMBS, whom we perceive to have been one of the chief promoters of its establishment.

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## VIII.—*Miscellaneous.*

### *Circular Instructions from the Geological Society, for the Collection of Geological specimens, with a plate.*

[We beg the attention of our Indian geologists to these simple instructions; to which we have only to add that numbers should be put on the stones, where possible, as paper labels are soon destroyed by insects in this country.]

1. The Geological Society begs to impress upon the minds of all collectors, that the chief objects of their research should be specimens of all those rocks, marls, or clays, which contain shells, plants, or any sort of petrifaction.

2. The petrifactions should, if possible, be kept united with portions of the rock, sand, or clay, in which they are found; it being more desirable that the mass should

be examined carefully when brought to England, than that any separation of the shells should be attempted at the time of their collection. This injunction, however, does not apply to those cases in which the shells fall readily from their surrounding matrix; but, in this event, great care must be taken of the petrifactions, by rolling them in paper, or some soft material.

3. If several varieties of stone are seen in the same cliff or quarry, and particularly if they contain any petrifactions, specimens of each should be taken, and numbered according to their order of succession; marking the uppermost No. 1., and thence descending with Nos. 2, 3, &c., making as correct an estimate as time will permit of the thickness of the beds. None of these specimens need be more than 3 in. square, and one and a half or two thick. (*fig.* 1.)

4. If the rocks are stratified, that is, divided into beds, state whether they are horizontal, inclined, or twisted. If inclined, observe pretty nearly at what angle, and to what point of the compass they dip; if twisted, a sketch, however slight, is desirable.—N. B. The true dip can seldom be ascertained without examining the beds on more sides than one. (*fig.* 2.)

5. One kind of rock is occasionally seen to cross and cut through the beds of another. In such a case, observe whether the beds are in the same plane on each side of the intruding rock; if not, mark the extent of the disturbance, and also if there be any difference in the nature of the stone of which the beds are composed, at those points where they touch the intruding rock. Take specimens from the junction, and make a sketch of it. (*fig.* 3.)

6. Where there are wells, get a list of the beds sunk through in digging them; specifying the thickness of each stratum in its order, from the surface downwards.

7. In volcanic districts, procure a list of the volcanoes now or recently in action, and of those which are extinct; stating their position, their distance from the sea or any great lake; the extent, nature, and, if possible, the age, of particular streams of lava, or the relative age of different streams: also whether the lava currents conform to the valleys, or are seen at different heights above the present rivers; and also if any gravel beds be discoverable beneath the streams of lava. (*fig.* 4.)

8. Note the names of all places known to contain coal, bitumen, salt, alabaster, metallic ores, or any valuable minerals, specifying their extent, and the nature of the rocks in which they occur; but do not bring away large quantities of iron ore, spar, salt, &c.

9. In cases of coal-pits, specimens of the coal itself and of the beds passed through to obtain it (especially when plants have been found) will be valuable. State whether limestone, iron ore, or springs of bitumen are found near the coal; and if the limestone contains shells, collect abundance of them.

10. Make particular inquiries whether, in digging gravel-pits, or beds of surface clay, mud, and sand, the workmen are in the habit of finding any bones of quadrupeds; and obtain as many of them as possible, selecting particularly teeth and vertebræ.

11. Search also for bones in cracks of rock, and in caverns. In the latter, the lowest pits or hollows are most likely to contain bones; and if the solid rock be covered with a crust of spar or marl, break through it, and dig out any bones, horns, or pebbles from beneath. (*fig.* 5.)

12. Observe if the surface of the country be strewed over with large blocks of stone; remark whether these blocks are angular or rounded, and whether they are

of the same or a different nature from the stratum on which they are laid. If the latter, endeavour to trace them to their native bed. Note the different heights at which gravel is found, and whether or not it is composed of the same rocks as the adjoining country.

13. Nautical collectors are requested to separate and preserve any shells or corals which may be brought up, either with the lead or the anchor; noting the depth and the locality.

14. On coasts where there is a considerable ebb tide, and where the shore consists of rocks or clay containing fossils, some of the best of these petrifactions may be looked for, by breaking up with a pick-axe the shelving beds exposed at low water.

15. In making sections, or memorandums, distinguish well upon the coast, between masses which have simply slipped and fallen away, and the real cliff itself.

16. When drift wood is met with at sea, collect pieces of it: note the longitude and latitude, the distance from the nearest land, and the direction of the current by which it has been borne. Examine well the state of the floating mass, and see whether any roots or leaves be attached to it.

17. Every specimen should be labelled on the spot, or as soon after collection as possible, and then rolled in strong paper, or any soft material, to protect its edges.

18. A heavy hammer to break off the specimens from the rock, and a smaller one to trim them into shape, are indispensable. If the larger hammer have a pick at one end, it will be found very useful in digging up and flaking off those thin shelly beds which usually contain the best preserved shells, &c. A chisel or two are also desirable.

19. The recommendation expressed in the instruction No. 1, may be repeated: —That it should be a general maxim with geological collectors to direct their principal attention to the procuring of fossil organic remains, both animal and vegetable. These are always of value when brought from distant countries; especially when their localities are carefully marked; but when the rocks contain no petrifactions, very small specimens are sufficient.

### 2.—*Mirrors of Fusible Alloy.*

Berzelius has found that by the union of nineteen parts of lead and twenty-nine of tin, fusible alloy is produced, which affords, on cooling in thin plates, very bright surfaces. A convex lens dipped several times into the melted alloy, yielded from the surface dipped, a concave mirror of great lustre. This, mounted upon plaster, was preserved for some time in the air untarnished. Dust destroys these mirrors, which will not bear wiping.—*Traité de Chimie.*

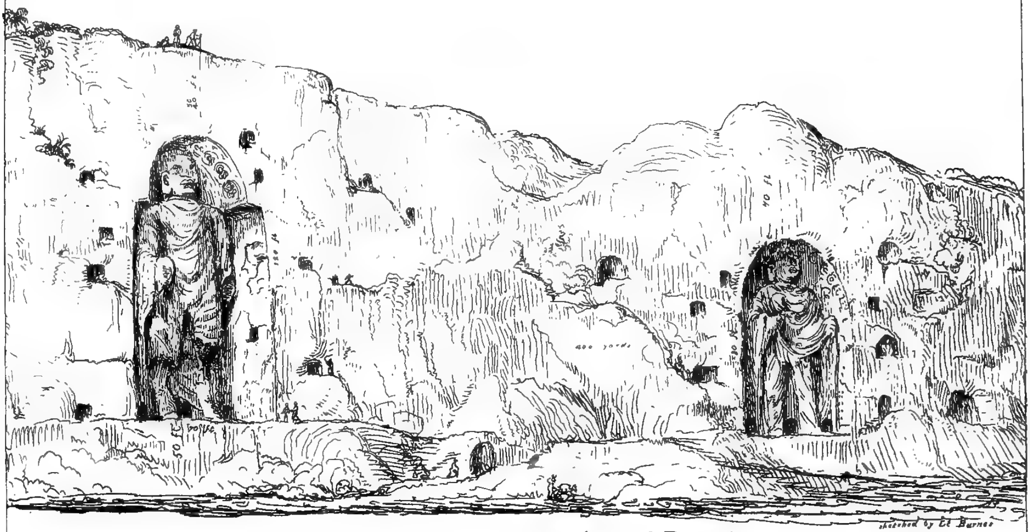
### 3.—*Liverpool and Manchester Railway.*

It appears from the account of the Company for the half year ending the 31st December last, that notwithstanding a diminution of nearly 74,000 in the number of passengers during July and August, (supposed to have been caused by the cholera), the loss on this account had, in a considerable degree, been made up by the greater quantity of merchandize conveyed, and a reduction in the general expenses of management. The total number of passengers during the half year, was 182,823 —the receipts £43,420. The merchandize conveyed amounted to 86,642 tons— receipts £37,781. The expenses, including £12,646 for repairs of engines, amounted to £48,278, leaving a clear profit of £37,781, which enables the Company to make a dividend, for the half year, of four guineas per share.—*Mech. Mag.*

*Meteorological Register, kept at the Assay Office, Calcutta, for the month of October, 1833.*

| Day of the month. | Barometer reduced to 32° Farh. At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10½ P. M. | Thermometer in the Air. Minimum at 4½ A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | Depression of moist-bulb Thermometer. At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | Hair Hygrometer. At 10 A. M. | At 4 P. M. | Rain. Inches. | Wind. Morning. | Noon. | Evening. | Weather. Morning. | Noon. | Evening. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ,570 | ,602 | ,511 | ,612 | 81,0 | 85,9 | 93,8 | 88,1 | 81,8 | 1,9 | 3,9 | 4,7 | 3,6 | 96 | 94 | | n. e. | E. | E. | clear. | cum. nim. | clear. |
| 2 | ,590 | ,645 | ,558 | ,657 | 80,0 | 85,7 | 101,5 | 87,4 | 81,2 | 2,0 | 4,4 | 5,0 | 3,8 | 95 | 93 | | E. | n. e. | s. e. | do | clr.showers | do |
| 3 | ,650 | ,694 | ,631 | ,682 | 79,2 | 85,9 | 92,4 | 86,2 | 81,8 | 2,0 | 4,6 | 5,1 | 3,8 | 94 | 93 | | n. e. | E. | E. | do | fine c. s. | do |
| 4 | ,653 | ,698 | ,588 | ,685 | 79,9 | 87,0 | 100,2 | 88,5 | 83,0 | 1,9 | 5,5 | 7,5 | 4,6 | 91 | 87 | | o. | E. | o. | do | do | do |
| 5 | ,662 | ,740 | ,633 | ,741 | 81,0 | 87,0 | 102,0 | 90,8 | 82,3 | 3,2 | 5,8 | 8,7 | 3,8 | 92 | 86 | | E. | n. e. | o. | do | do | showers |
| 6 | ,744 | ,804 | ,670 | ,788 | 81,6 | 86,7 | 94,6 | 90,2 | 83,1 | 3,5 | 5,2 | 7,7 | 5,1 | 93 | 87 | | w. | e. | E. | do | do | clear. |
| 7 | ,744 | ,740 | ,712 | ,773 | 81,8 | 88,0 | 94,0 | 81,4 | 78,2 | 3,1 | 6,1 | 4,4 | 1,7 | 92 | 96 | 2,28 | o. | s. w. | E. | do | cum.strat. | rain. |
| 8 | ,727 | ,769 | ,690 | ,729 | 76,7 | 82,8 | 88,6 | 84,2 | 79,4 | 0,7 | 3,8 | 4,3 | 1,9 | 98 | 96 | | o. | n. e. | n. e. | haze. | foggy. | rn .haze. |
| 9 | ,670 | ,750 | ,652 | ,732 | 78,4 | 82,4 | 86,2 | 83,5 | 78,7 | 1,4 | 3,4 | 3,6 | 2,0 | 98 | 97 | | n. e. | n. w. | n. e. | clear. | overcast. | do |
| 10 | ,694 | ,761 | ,666 | ,780 | 77,0 | 82,6 | 85,6 | 84,5 | 80,5 | 1,8 | 3,5 | 4,2 | 2,0 | 98 | 96 | 0,14 | n. e. | s. e. | o. | haze. | do | overcast. |
| 11 | ,742 | ,826 | ,733 | ,836 | 80,0 | 83,8 | 87,3 | 87,5 | 78,3 | 1,6 | 2,8 | 3,1 | 1,5 | 97 | 96 | | n. e. | o. | o. | overcast. | do | do |
| 12 | ,792 | ,867 | ,733 | ,798 | 77,3 | 83,0 | 92,8 | 84,7 | 81,8 | 1,3 | 3,3 | 3,6 | 3,8 | 96 | 95 | | n. | o. | o. | do | cumuli. | clear. |
| 13 | ,753 | ,787 | ,660 | ,749 | 78,2 | 84,0 | 93,8 | 85,9 | 81,0 | 3,6 | 3,5 | 4,5 | 3,5 | 95 | 93 | | o. | s. w. | s. e. | clear. | fine. | nwr. clear. |
| 14 | ,745 | ,816 | ,710 | ,775 | 78,2 | 83,3 | 92,6 | 85,1 | 82,6 | 3,1 | 4,0 | 6,3 | 4,8 | 94 | 88 | 1,26 | o. | n. w. | o. | rain. | cumuli. | clear. |
| 15 | ,767 | ,837 | ,724 | ,746 | 80,7 | 84,6 | 95,9 | 87,1 | 84,2 | 2,9 | 4,4 | 6,7 | 5,4 | 94 | 87 | | o. | s. w. | o. | clear. | clear. | do |
| 16 | ,804 | ,867 | ,750 | ,826 | 84,0 | 85,9 | 96,1 | 88,7 | 84,8 | 3,7 | 5,0 | 8,4 | 6,7 | 93 | 85 | | o. | N. | o. | do | do | do |
| 17 | ,799 | ,862 | ,728 | ,702 | 81,2 | 86,3 | 97,8 | 90,0 | 85,1 | 2,8 | 7,2 | 10,6 | 7,6 | 90 | 80 | | o. | n. | o. | do | cumuli. | do |
| 18 | ,784 | ,826 | ,730 | ,803 | 81,0 | 86,9 | 94,1 | 90,0 | 82,0 | 4,1 | 6,0 | 10,2 | 3,3 | 89 | 80 | | o. n. | w. | S. | do | fine. | do |
| 19 | ,790 | ,852 | ,764 | ,823 | 79,2 | 87,0 | 94,6 | 90,5 | 81,1 | 1,2 | 6,0 | 10,2 | 2,1 | 91 | 81 | | s. | s. | S. | do | clear. | do |
| 20 | ,759 | ,878 | ,795 | ,856 | 79,3 | 87,2 | 93,3 | 90,3 | 81,3 | 1,7 | 7,5 | 9,6 | 3,8 | 88 | 86 | | S. | o. | s. | do | do | do |
| 21 | ,850 | ,902 | ,818 | ,868 | 79,2 | 87,5 | 95,0 | 90,2 | 82,0 | 1,2 | 8,5 | 9,3 | 4,3 | 85 | 90 | | o. | S. | s. | do | do | cirri. |
| 22 | ,850 | ,894 | ,786 | ,830 | 80,2 | 87,2 | 94,8 | 90,0 | 81,1 | 2,0 | 7,4 | 9,6 | 4,1 | 87 | 83 | | o. | S. | s. | fog. | do | clear. |
| 23 | ,832 | ,900 | ,842 | ,922 | 80,0 | 87,5 | 94,0 | 89,7 | 79,2 | 2,2 | 7,2 | 9,6 | 4,2 | 88 | 84 | | s. | s. | E. | clear. | do | cir. cum. |
| 24 | ,918 | ,991 | ,910 | ,969 | 78,1 | 87,0 | 94,2 | 89,5 | 78,2 | 1,7 | 6,1 | 10,0 | 6,2 | 90 | 82 | | o. | s. | E. | do | do | clear cold. |
| 25 | ,969 | ,044 | ,931 | ,004 | 76,7 | 86,2 | 97,5 | 88,5 | 82,7 | 3,1 | 5,7 | 8,2 | 5,6 | 90 | 86 | | s. e. | n. | o. | do | do | clear. |
| 26 | ,964 | ,050 | ,902 | ,962 | 78,1 | 86,5 | 97,1 | 88,8 | 78,8 | 3,0 | 6,0 | 9,2 | 6,3 | 90 | 84 | | o. | o. | n. | do | do | cir. cum. |
| 27 | ,936 | ,025 | ,880 | ,932 | 76,4 | 85,0 | 93,5 | 87,0 | 76,1 | 3,4 | 6,0 | 9,1 | 4,3 | 90 | 84 | | n. | o. | o. | do | do | rn. nwr. |
| 28 | ,916 | ,000 | ,858 | ,929 | 75,8 | 83,8 | 90,5 | 86,1 | 79,2 | 3,5 | 6,0 | 9,0 | 6,6 | 89 | 85 | | n. w. | n. w. | N. W. | cir. cum. | cumuli. | cum. str. |
| 29 | ,950 | ,992 | ,883 | ,926 | 76,1 | 82,2 | 91,0 | 85,5 | 77,7 | 3,1 | 7,0 | 10,0 | 6,6 | 90 | 82 | | N. | w. | N. o. | do | do | cirri. haze. |
| 30 | ,925 | ,008 | ,921 | ,973 | 74,2 | 81,0 | 88,8 | 83,7 | 77,1 | 4,2 | 7,0 | 11,5 | 5,1 | 88 | 77 | | N. E. | w. | N. o. | cir. str. | do | haze. |
| 31 | ,962 | ,026 | ,927 | ,976 | 74,2 | 81,3 | 90, | 84,1 | 77,0 | 4,0 | 10,7 | 12,6 | 6,5 | 80 | 75 | | n. e. | n. | N. | clear. | clear. | clear. |
| Mean, | ,790 | ,860 | ,751 | ,819 | 78,8 | 85,2 | 93,5 | 86,8 | 80,7 | 2,5 | 5,6 | 7,6 | 4,3 | 91 | 87 | 3,68 | | calms. | | | fine weather. | |

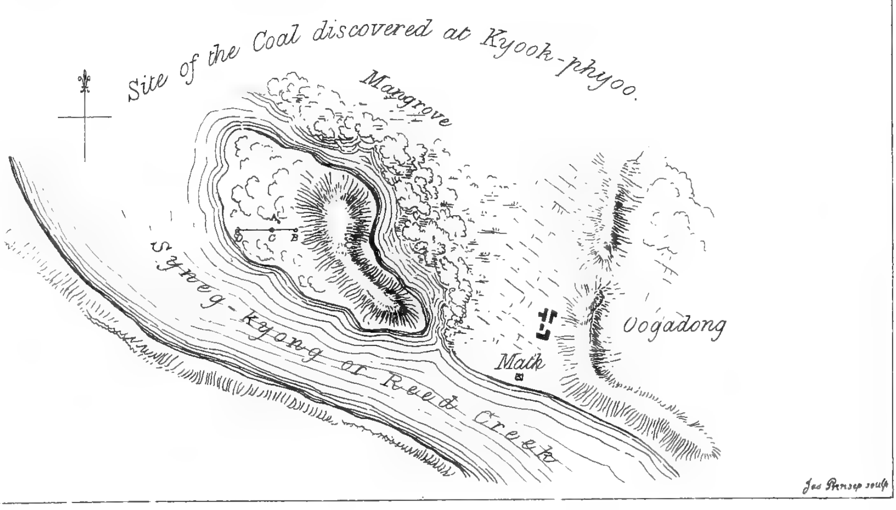
On the 4th at 7 h. 45 m. A. M. an earthquake was felt in Calcutta, and more severely at Monghyr, Patna, Tirhoot, the Rotas hills, Allahabad, &c.; on the 18th another shock was experienced at the same places more moderate and of shorter duration. On the 26th a third was felt in Nipal, and more moderately on the plains.




The Colossal Idols, or Búts, of Bamian.

The Tope of Belar. (see p. 309)

Site of the Coal discovered at Kyook-phyoo.



# JOURNAL

OF

# THE ASIATIC SOCIETY.

*No. 23.—November, 1833.*


## I.—*On the Colossal Idols of Bamián. By Lieut.* Alexander Burnes, *Bombay Army.*

On the 23rd, we reached *Bamián,* which is celebrated for its idols and excavations. These caves are to be seen in all parts of the valley for about eight miles, and they still form the residence of the greater part of the population. They are called "*Súmach*" by the people. A detached hill in the middle of the valley is quite honey-combed with them, and brings to our recollection the Troglodytes of Alexander's historians: it is called the city of *Ghulghula,* and consists of a continued succession of caves in every direction, which are said to have been the work of a king named *Julál.* The hill of *Bamián* is formed of hardened clay and pebbles, which renders its excavation a matter of little difficulty, but the great extent to which this has been carried excites attention. Caves are found on both sides of the valley, but the greater number are on the northern side, where we found the idols: altogether they form an immense city. Labourers are frequently hired to dig in the ruins, and their labours are rewarded by rings, reliques, coins, &c. They generally bear Cufic inscriptions, and are of a later date than the age of Muhammed. These excavated caves or houses have no pretensions to architectural ornament, being no more than squared holes in the hill: some of them are finished in the shape of a dome, and have a carved frieze below the point from which the cupola springs. The inhabitants tell many remarkable tales of the caves of *Bamián,* one in particular, that a mother lost her child among them, and recovered it after a lapse of 12 years! The tale need not be believed, but it will convey an idea of the extent of the works. There are excavations on all sides of the idols, and in the larger one half a regiment might find quarters.

*Bamián* is subject to *Cábul,* and would appear to be a place of high antiquity; it is perhaps the city which Alexander founded at the base of Paropamisus before entering Bactria. The country indeed from *Cábul* to *Balkh* is yet styled '*Bakhtar-zamín,*' or the *Bakhtar* country. The name of *Bamián* is said to be derived from its elevation, '*Bám,*' signifying balcony, and the affix '*ian,*' country. It may be so called from the caves rising over one another in the rock.

There are no reliques of Asiatic antiquity which have more roused the curiosity of the learned than the colossal idols of *Bamián.* It is fortunately in my power to present a drawing of these images. They consist of two figures, a male and a female; the one named Salsal, the other Shah Mama. The figures are cut in alto relievo in the face of the hill, and represent two colossal images. The male is the largest of the two, and about 120 feet high. It occupies a front of 70 feet, and the niche in which it is excavated extends about that depth into the hill. This idol is mutilated, both legs having been fractured by cannon, and the countenance above the mouth is destroyed. The lips are very large, the ears long and pendent, and there appears to have been a tiara on the head. The figure is covered by a mantle, which hangs over it in all parts, and seems to have been formed of a kind of plaster, and the image has been studded in various places with wooden pins to assist in fixing it. The figure itself is without symmetry, and there is no elegance in the drapery. The hands which held out the mantle have been both broken.

The female figure is more perfect than the male, and has been dressed in the same manner. It is cut out of the same hill, at the distance of 200 yards, but is not half the size. One could not discover that her ladyship was not a brother or a son of the twin colossus, but for the information of the natives. The drawing which is attached will convey better notions of these idols than a more elaborate description. The square and arched apertures which appear in the plate represent the entrance of the different caves or excavations, and through these there is a road which leads up to the summit of both the images. In the lower caves the caravans to and from *Cábul* generally halt, and the upper ones are used as granaries by the community.

I have now to note the most remarkable curiosity in the idols of *Bamián.* The niches of both have been at one time plastered and ornamented with paintings of human figures, which have now disappeared from all parts but that immediately over the heads of the idols. Here the colours are as vivid and the paintings as distinct as in the Egyptian tombs. There is little variety in the design of these figures, which represent the bust of a woman with a knot of hair on the head and a plaid half over the breast, the whole surrounded by a halo, and the head again by another halo. In one part I could trace a group of three female figures following each other. The execution of the work is bad, and by no means superior to the pictures which the Chinese make in imitation of an European artist.

The traditions of the people regarding the idols of *Bamián* are vague and unsatisfactory. It is stated that they were excavated about the Christian era by a tribe of kaffirs (infidels), to represent a king named SALSAL and his wife, who ruled in a distant country, and was worshipped for his greatness. The Hindús assert them to have been excavated by the Pandús, and that they are mentioned in the great epic poem of the *Mahábhárat.* Certain it is that the Hindús on passing these idols at this day hold up their hands in adoration, though they do not make offerings, which may have fallen into disuse since the rise of Islam. I am aware that a conjecture attributes these images to the Buddhists, and the long ears of the great figure make it probable enough. I do not trace any resemblance to the colossal figures in the caves of Salsette near Bombay, but the shape of the head is not unlike that of the great trifaced idol of Elephanta. At *Manikeala,* in the *Panjáb,* near the celebrated '*Tope,*' I found a glass or cornelian antique which exactly resembles this head. In the paintings over the idols I discover a close resemblance to the images of the Jain temples in Western India, in mount *Abú,* and at *Girvan* and *Palitana* in *Katywar.* I judge the figures to be female, but they are very rude, though the colours in which they are sketched are bright and beautiful. There is nothing in the images of *Bamián* to evince any great advancement in the arts, or what the most common people might not have executed with success. They cannot certainly be referred to the Greek invasion, nor are they mentioned by any of the historians of ALEXANDER's expedition. I find in the history of TIMOURLANE, that both the idols and excavations of *Bamián* are mentioned by SHERI'F UD DIN, his historian. The idols are described to be so high that none of the archers could strike the head. They are called LAB and MANAB, two celebrated idols which are mentioned in the Koran; and the writer also alludes to the road which led up to them from the interior of the hill. There are no inscriptions at *Bamián* to guide us in their history, and the whole of the later traditions are so mixed up with ALI, the son-in-law of MUHAMMED, who we well know never came into this part of Asia, that they are most unsatisfactory. It is by no means improbable that we owe the idols of *Bamián* to the caprice of some person of rank, who resided in this cave-digging neighbourhood, and sought for an immortality in the colossal images which we have now described.

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## II.—*Account of the Earthquake at Kathmandú. By* A. Campbell, *Esq. Assistant Surgeon, attached to the Residency.*

On the 26th of August last, about 6 o'clock P. M. a smart shock of earthquake was experienced throughout the valley, and the neighbouring hills, westward in the valley of *Nayakot* and *Dúny Byas*; eastward at *Panoutí, Baneppa, Dulkele,* and *Pholam Chók;* and southward at *Chitlong, Chisagarhy, Etounda,* and *Bissoulea.* The shock was preceded by a rumbling noise from the eastward. The motion of the earth was undulatory, as of a large raft floating on the ocean, and the direction of the swell was from north-east towards south-west. The shock lasted about 1 minute. At 10-45* P. M. of the same day another shock of equal duration and of the same character occurred, and at 10-58, a third and most violent one commenced: at first it was a gentle motion of the earth, accompanied by a slight rumbling noise; soon however it increased to a fearful degree, the earth heaved as a ship at sea, the trees waved from their roots, and houses moved to and fro far from the perpendicular. Horses and other cattle, terrified, broke from their stalls, and it was difficult to walk without staggering as a landsman does on ship-board. This shock lasted for about three minutes in its fullest force. And the following is as correct an estimate as can be ascertained (without official documents) of the damage done by it to life and property throughout the great valley and neighbouring districts of Nipal. It is believed that the two first shocks were harmless†.

* Not by chronometer, but by a good-going clock, which stopped during the great shock. Its pendulum vibrated north and south. [If the clock was set by the sun, the shock must have been 51m. earlier than in Calcutta.—Ed.]

† Doctor Campbell's subsequent letters inform us, that there have been frequent shocks of less violence since the above, many of which (on the 4th and 18th Oct. particularly) were felt at Calcutta, Monghyr, Chittagong, Allahabad, and Jabalpúr, nearly simultaneously. On the 26th Oct. he writes, "At 10h. 45m. A. M. a sharp shock of the dangerous or undulating kind occurred. The embassy has returned from China, and I am informed that the great shock was not felt at Lassa, so that it would appear to have been confined to India within the Himálaya."—Ed.

*Number of Lives lost and Buildings destroyed.*

| Places. | Killed. | Wounded. | Houses. | Temples and other Buildings. |
|---|---|---|---|---|
| British Residency grounds, | none | none | 1 | none. |
| City of Kathmandú, | 60 | 38 | 400 | Two pillars, built by the minister, each upwards of 100 feet high: the large Temple of Jagarnáth, built by Rán Bahadur, after seven years labour, and about a dozen temples, destroyed. The modern-built garden houses of several members of the minister's family have been rendered untenantable; one of them, a handsome and ornamental edifice, has come to the ground. |
| *South of Capital.* | | | | |
| Patan, | 6 | 25 | 285 | |
| Sano gaon, | none | 0 | 40 | |
| Harra Siddhi, | 0 | 0 | 20 | |
| Teshu gaon | 0 | 0 | 25 | |
| Selli gaon, | 0 | 0 | 16 | |
| Pagah, | 0 | 0 | 24 | |
| Kúknah, | 1 | 0 | 130 | |
| Baghmatí, | 0 | 0 | 80 | A crack in the ground of 20 feet in length was observed at this village on the morning of the 27th; the entire number of houses in it was 206, more than a third of the whole were destroyed, and about 100 men have been much damaged. The injury sustained here is proportionally greater than in any other part not to the east of Kathmandú. |
| Phurphing, | 0 | 0 | 8 | |
| Chappa gaon, | 0 | 0 | 35 | |
| Peang, | 0 | 0 | 8 | |
| Taibú, | 0 | 0 | 18 | |
| Bara gaon, | 0 | 0 | 35 | |
| Balí, | 0 | 0 | 3 | |
| Pahon, | 0 | 0 | 3 | |
| Sasanelly, | 0 | 0 | 2 | |
| Lúbú, | 0 | 0 | 25 | |
| Sana, | 0 | 0 | 7 | |
| Hills about Sasanelly, | 0 | 0 | 20 | |
| *East of Kathmandú in the valley.* | | | | At the eastern extremity of Deo Patan is the Temple of Paspatnáth, containing Pusputi Jee, the patron deity of the Brahminical inhabitants of Nipal. The building escaped unhurt to the great joy of the rulers and people of the land, who attribute the circumstance solely to the interference of the blind goddess, in behalf of their favourite god, rather than to the stout deposition of brick and mortar. |
| Deo Patan, | 3 | 0 | 30 | |
| Handi gaon, | 0 | 0 | 20 | |
| Nág Dèsa, | 4 | 0 | 20 | |
| Bareh*, | 5 | 0 | 20 | |
| Temi, | 0 | 0 | 150 | |
| Gou Karan, | 0 | 0 | 8 | |
| Changu, | 0 | 0 | 20 | A fine old temple destroyed. |
| Sankhú, | 20 | 5 | 45 | A handsome Temple of Mahadeo, situated on a hill above Sankhú, is reduced nearly to ruins. |
| Bhat gaon, | 200 | 104 | 2000 | The total number of houses in Bhat gaon is reckoned by Mr. Hodgson at 4,700, ⅗th of the town is said to be destroyed, 2,000 is the average of many accounts, six or eight fine temples destroyed, and a statue of Rajah Ranjit Mall, one of the Newar Princes of the Bhat gaon division of the valley. |
| *East of Kathmandú beyond the valley, but in the immediate neighbourhood.* | | | | |
| Sangu, | 2 | 0 | 8 | |
| Baneppa, | 10 | 0 | 20 | |
| Nala gaon, | 6 | 0 | 11 | |
| Panoutí, | 18 | 0 | 19 | Six persons were killed under the ruins of one house in this village, their remains were found where they had gone to sleep. |
| Dulkele, | 10 | 0 | 21 | |
| Phulam Chok, | 60 | 0 | 300 | A fine temple destroyed here. |

* One woman became *Satti* at this village, her husband having been killed.

| Places. | Killed. | Wounded. | Houses. | Temples and other Buildings. |
|---|---|---|---|---|
| *North-east of the valley and more remote.* | | | | |
| Dhulaka, .. ...... | 0 | 0 | 0 | In this direction the earthquake was much more severely felt. Kúti, a town on the Bhote frontier, on the road to Lassa, is said to have been nearly all destroyed, it contained about 600 houses ; 50 of which only remain. At Listi gaon, also on the Bhote frontier, a large portion of a hill came down, and an iron bridge was destroyed. At Kan Sing Choke, in the same direction, vulgar report says, that for five days before the earthquake took place, noises similar to the firing of cannons were heard as if under ground : and in this neighbourhood the high road to Lassa is said to be in many places blocked up by the fallen earth from the mountains. |
| Mundun Pahar, .... | | | | |
| Kan Sing Chok, .. | | | | |
| Kassa,.......... ...... | | | | |
| Kuti, ...... ...... | | | | |
| Listi gaon, ........ | | | | |
| Shípa—the country residence of Colonel Runbír Sinh, 20 miles from Kathmandú on the Lassa road, by the Kuti Pass, is seriously injured. Many small houses attached were destroyed and several lives lost. | | | | |
| *West of Kathmundú.* | | | | |
| Swambunáth,...... | 0 | 0 | 3 | One small temple destroyed, and the large one a little injured. The form of the large one must have preserved it. It is the chief Buddhist Temple in the valley, built in the fashion of that religion—an immense circular mound of brick work, surmounted by a 4-sided spire or jweet. |
| Hál Chok,.. ...... | 0 | 0 | 3 | |
| Narod Deví, .. .... | 0 | 0 | 1 | |
| Changu Naráyan, .. | 0 | 0 | 2 | |
| GoorkhaCantonment or Campoo,...... | 0 | 0 | 4 | The house of a Captain much injured here. |
| Kirtipur, .......... | 0 | 0 | 14 | Contains 532 houses, and is built along the ridge and brow of a hill 300 feet higher than the surrounding part of the valley. Its tenements are old and frail. To account for its escape, the inhabitants say, " That some nights previous to the earthquake, and on the memorable night itself, a large tiger or leopard paraded several streets of the town, without molesting any of the inhabitants. This forbearance was reciprocal, for the " guardian angel" was allowed to continue his protecting visits : the admiring crowd, firm in the belief of correct vision, hailed him as Ramji', another incarnation of the " great preserver." |
| Thankote, .... .... | 0 | 0 | 23 | |
| *West of the valley.* | | | | |
| Duny Byas and neighbouring hills, | 10 | 0 | 40 | |
| Tewanpur, ....... .. | 0 | 0 | 10 | |
| Nayakoth, .... .... | 0 | 0 | 3 | |
| *North of Kathmandú* | | | | |
| Dharmtulí, ........ | 0 | 0 | 2 | |
| Hukm gaon, ..... .. | 0 | 0 | 1 | |
| Toka goan,........ | 0 | 0 | 15 | |
| Burha Níl Kanth, | 0 | 0 | 2 | |
| Chapaly, .......... | 0 | 0 | 7 | |
| Dharmpur,...... .... | 0 | 0 | 20 | |
| *South of the valley.* | | | | |
| Chitlong,......... | 0 | 0 | 14 | |
| Chisagarhy, ...... | 0 | 0 | 0 | The fort here much injured : a large portion of the breastwork facing the south has fallen, and the wall in many other places, although not fallen, is seriously injured. |
| Mukwánpur,.... .. | 0 | 0 | 0 | The fort here has also suffered, but in a much less degree than the one at Chisapany. |
| Total,...... ...... | 414 | 172 | 4040 | |

The above shews that the earthquake was much more severe to the north and east of the valley than here; and that even within the valley it was much more violent to the east of *Kathmandú* than at the capital itself, or other places to the west of it. The town of *Bhat gaon* is not more than eight miles in a straight line from *Kathmandú*, and even there its violence must have greatly exceeded what it was at the latter place. To account for the immense disproportion in the loss of life and property at both places, something may be allowed for the more frail state of the buildings at *Bhat gaon;* but this is not sufficient, and this circumstance must be considered as inexplicable as most others attending this fearful phenomenon. The brahmans of Nipal say (and it is believed with truth) that the occurrence of a more violent earthquake than this is recorded in their histories. It was about 600 years ago, and then the cities of *Mangah, Patan,* and innumerable towns were utterly destroyed and thousands of their inhabitants killed* : the modern capital *Kathmandú* did not then exist.

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## III.—*Census of the Population of the City and District of Murshedabad, taken in* 1829.

To the five or six accurate estimates which we possess of the population of the cities of India, we are happy to be able now to add one of *Murshedabad,* both city and district, which we owe to the private or ex-official industry of Mr. H. V. Hathorn, while magistrate of that zillah in 1829. The detailed statements accompanying this officer's letter to the Government will be published without doubt in the Transactions of the Asiatic Society, to which body they have besn transferred : we proceed however, as on former occasions, to offer an abridged analysis of the tables, that the readers of the Journal may be in possession of all the accurate statistical knowledge of India furnished from authentic data. How easy would it be for every officer in charge

* The *Jyotishis* say that the planets Jupiter and Saturn were at the occurrence of this present one in the same situation as when the above destructive one happened. From this greater mischief was for many days after the 26th hourly expected, and many lucky moments were fixed upon by the said astrologers for the catastrophe ; but all fortunately have come to nought, and although slight shocks continued to recur until about the 15th instant, no addition has been made to the effects of the one great paroxysm of the 26th.

of a town or a zillah to employ a few of the leisure hours of his police in framing reports of a similar nature.

Mr. Hathorn describes his mode of proceeding as follows:

"The work was done under my personal superintendence, through the medium of the Darogas, who were furnished with blank forms, accompanied with particular instructions as to the mode to be adopted in estimating the establishment of natives of rank and respectability, in order to be as accurate as possible in point of numbers, and at the same time to avoid giving offence by requiring a detailed statement of their dependants of both sexes." "I regret that my sudden departure from Murshedabad, in 1829, and my absence in England, for a period of three years, on account of health, has prevented me from revising and submitting these papers at an earlier period."

*Population of the City of Murshedabad.*

| Names of Thannas. | Number of Houses. Musulman. | Hindú. | Total. | No. of Inhabitants. Musulmans. | Hindus. | Total. |
|---|---|---|---|---|---|---|
| Mura gowar, ....... | 156 | 300 | 456 | 935 | 1557 | 2492 |
| Pul Hasan Ullah Khan, | 1161 | 936 | 2127 | 4780 | 3554 | 8334 |
| Man Ullah bazár, .... | 337 | 1551 | 1888 | 1841 | 5557 | 7398 |
| Rájá Bazar, ........ | 1600 | 1122 | 2722 | 4914 | 3425 | 8339 |
| Akhara Ramshah, .... | 330 | 2978 | 3308 | 1390 | 12132 | 13522 |
| Mohémpur, ........ | 322 | 1196 | 1518 | 1174 | 3854 | 5028 |
| Gundítala, .......... | 1323 | 752 | 2075 | 2871 | 1627 | 4498 |
| Nakla khálí, ........ | 625 | 593 | 1218 | 1825 | 1760 | 3585 |
| Sháhnagar, .......... | 788 | 897 | 1685 | 4000 | 2282 | 6282 |
| Jân Mahomedpur,.... | 1375 | 1849 | 3224 | 5820 | 5330 | 11150 |
| Kasim bazar, ........ | 491 | 809 | 1300 | 1325 | 2213 | 3538 |
| Kalkapur, .......... | 422 | 778 | 1200 | 1602 | 2314 | 3916 |
| Suja ganj, .......... | 566 | 2887 | 3453 | 2408 | 12010 | 14418 |
| Ranisar, ............ | 369 | 1749 | 2118 | 1653 | 6554 | 8207 |
| Mahájan tola,........ | 269 | 1551 | 1820 | 843 | 2146 | 2989 |
| Rájbárí, ............ | 939 | 1979 | 2918 | 2510 | 5356 | 7866 |
| Asanpura, .......... | 290 | 1882 | 2172 | 3043 | 3109 | 6152 |
| Berhampur, ........ | 839 | 1279 | 2118 | 4832 | 7322 | 12154 |
| Fort, .............. | 2049 | 749 | 2798 | 8324 | 7984 | 16308 |
| Total of the City, .... | 14281 | 25837 | 40118 | 56090 | 90086 | 146176 |
| Add for strangers,.... | .. | .. | .. | .. | .. | 787 |
| Total population, .... | .. | .. | .. | .. | .. | 146963 |

| | males. | females. |
|---|---|---|
| Proportion of sexes, Musulmáns, ...................... | 28442 | 27648 |
| Hindús, .......................... | 44438 | 45648 |
| Number of inhabitants per house, Musulmáns,............ | 3.90 | |
| Hindús,................ | 3.48 | |
| Average of the whole, .................................. | 3.66 | |

*Population of the District of Múrshedabad.*

| Names of Thannas. | Number of villages in each. | Number of houses Musulman. | Hindu. | Total. | Number of Inhabitants. Musulmans. | Hindus. | Total. |
|---|---|---|---|---|---|---|---|
| Gokaru, .... | 149 | 2666 | 7724 | 10390 | 12771 | 38045 | 50816 |
| Gowas, .... | 87 | 8395 | 5427 | 13822 | 46716 | 27653 | 74369 |
| Khára,....... | 114 | 3702 | 3413 | 7115 | 17863 | 16070 | 33933 |
| Sulatábád, .. | 158 | 5612 | 6904 | 12516 | 25368 | 30836 | 56204 |
| Sútí, ...... | 128 | 3021 | 1795 | 4816 | 28499 | 6163 | 34662 |
| Harharpárá, | 86 | 3862 | 7290 | 11152 | 16282 | 36827 | 53109 |
| Govindpur, .. | 121 | 1988 | 6166 | 8154 | 12305 | 27159 | 39464 |
| Sharsherganj, | 87 | 8395 | 5427 | 13822 | 40416 | 27023 | 67439 |
| Kalyánganj,.. | 113 | 868 | 4626 | 5494 | 4444 | 21865 | 26309 |
| Nowadah, .. | 33 | 1782 | 2732 | 4514 | 10460 | 12311 | 22771 |
| Jalinghí .... | 73 | 3944 | 3619 | 7563 | 19197 | 20598 | 39795 |
| Chendaga .. | 70 | 613 | 2302 | 2915 | 2820 | 10102 | 12922 |
| Ranítaláo, .. | 157 | 5780 | 6733 | 12513 | 34649 | 34768 | 69417 |
| Bhadrihát, .. | 129 | 1269 | 3904 | 5173 | 5890 | 15500 | 21390 |
| Banwa, .... | 104 | 5080 | 10739 | 15819 | 16441 | 48012 | 64453 |
| Mirzapur, .. | 168 | 2862 | 10682 | 13544 | 14576 | 51615 | 66191 |
| Dewánsaray, | 141 | 4483 | 4634 | 9117 | 21831 | 22375 | 44206 |
| Bhartpur, .. | 152 | 6131 | 3541 | 9672 | 26198 | 18302 | 44500 |
| Total of the district, .. | 2070 | 70453 | 97658 | 168111 | 356726 | 465224 | 821950 |

Add for strangers or non-residents,.. ........................... 534

822484

| | Males. | Females. |
|---|---|---|
| Proportion of sexes, Musulmans, | 188036 | 168696 |
| Hindus, | 241710 | 223514 |
| | 429746 | 392210 |

Total of the Town and District, Houses, 208229

Inhabitants, 969447

Ratio of inhabitants per house, 4.73

## IV.—*List of Birds, collected in the Jungles of Borabhúm and Dholbhúm. By Lieut.* S. R. Tickell, 31*st Regt. N. I.*

1. FALCO LATHAMI. *Colvy Falcon?* LATHAM. Male. From head to tip of tail 18 inches, breadth of wings 40 inches; eyes orange yellow, bill and cere bluish, top of head in front grey, sinciput pale orange-brown; feathers streaked dark and produced into a long horizontal crest, the end feathers of which are black, tipped with white; face and auriculars ashy; back of neck and top of back, pale rusty; feathers centered dark-grey brown; whole of back, scapulars, primaries, and part of tertials, dark clouded rich brown; coverts of wings pale rusty, clouded grey-brown, and blotched with white spots; some of the tertials



South of Behar and Orissa

the same, greater coverts reddish ash-brown ; tail dark greyish brown, barred broadly with dark brown, and tipped obscurely white (as are the tertials), under parts white ; streak of black down centre of throat, neck white tinged rusty, broad bars of rusty on breast and belly, spots of the same on thighs; legs clothed with short white feathers to the feet, which are of a horny color ; exposed part of the tarsi reticulated, claws black and solid. The head is broad, eyes protruding, crest erectile, bill with scarcely any notch, legs short and stout, body muscular and compact.

This subject was killed at Sísdah, in Borabhúm, in dense bambú jungle, occupying the interval between two ranges of hills. It was one of a pair; the other, probably the female, appeared larger and showed more white on the wing. They perched high on the summits of tall decayed trees, and uttered wild plaintive screams. (The only specimen seen.)

2.—(*Honey Buzzard ?*) Length 19 inches, spread of wings 44. Female. Eyes yellow, bill blue, lores green, top of head, nape, and sides of chin, (at base of the bill,) white, streaked brown ; whole upper parts uniform clear ambre-brown, brightest on wings, dunnish on back, upper tail coverts pale rusty and whitish grey. Tail a hoary gull grey, primaries do. but darker and bluer : some of the outer ones nearly black, 3rd quill longest; under part a clear reddish brown, legs yellow. (Tarsi reticulated.) Killed at Kosmak, in Borabhúm, in thick grass jungle, perching on the ground. Stomach contained lizards. It was in company with the annexed.

3. *Falco Herbæcola. *Kohee Falcon,* T. Female. Length 18 inches, breadth 39. Aspect keen, body light and elegant, tail and wings long, tarsi elongated ; bill blue, tipped black, eyes dark, lores and legs yellow ; eyebrows, forehead, patch under the eye, and an indistinct ring round the neck, whitish ; whole upper parts pale brown, margined as in our female Kestrel (F. Tinnunculus), greater coverts dark lead brown, primaries brownish hoary grey, banded dark brown ; upper tail coverts white, with reddish brown crescent-shaped marks ; tail, two middle feathers full hoary grey, two next do. melting into rusty towards their shafts, outer ones pale rusty greyish white, the whole broadly bunded with sepia ; upper half of outside tail-feathers banded rusty and white : all the feathers tipped white. Breast, belly, vent, &c. striped brown and fawny white as in female Kestrel.

* The names of such birds, as have never come under my notice before, and are necessarily of my own coining, I have distinguished by the addition of a T.

This and the foregoing species appeared tolerably common in those immense tracts of grass jungle which extend with little intermission from near the Kossai river, to the base of the Lakisinní hills, in Sutrakehaní. They perch on the ground, or on the small babúl trees which are interspersed among the jungle, occasionally soaring with a low steady flight over the top of the grass, in quest of prey. They are called by the Hindus inhabiting those regions, "Shahín" and "Kohí," and are much prized by the Coles for their hawking qualifications. The stomach of the present subject contained greater part of a Myna.

4. Falco Nisosimilis. *Jungle Sparrow-Hawk,* T. Size and shape of English sparrow-hawk, upper parts and head a dun-brown; upper tail coverts pale obscure brown; tail as back, with four cloudy bands, tipped lighter; quills as back, eyebrows and forehead white; feathers tipped dark, auriculars, cheeks, and throat white with short brown stripes. Breast, belly, and thighs white, with transverse brown streaks, vent white. Thigh feathers each a little lower than knee, legs and toes long and slender as in sparrow-hawk. Bill and cere pale bluish, lore with dirty white bristles. Eyes pale gold, legs yellow, (tarsi scutellated): wings reach to the middle of tail, 4th and 5th quills longest. Eyes operculated by the brow as in F. Nisus. Male. Stomach contained lizards. Killed at Marcha, in Borabhúm. Frequents topes and cultivation.

5. Strix Dumeticola. *Jungle Horned Owl,* T. Male. From head [illegible]
to end of tail 1 feet 9 inches, spread of wings 4 feet 4. Eyes deep gold, bill black, legs horny, and bare; claws black: whole upper parts, face, and crest pale brown; feathers centred darker, wings do. mottled with grey and blotched occasionally white; primaries and tail pale-brown, barred darker. Breast, belly, thighs and vent tawny-white, barred transversely with rusty and striped longitudinally dark brown.

Frequents the thickest jungle, in deep retired dells, between high rocks or scarped hills, perching low and passing the midday in the centre of some impervious thicket. It is however partially diurnal, and easily flushed in the brightest day, when it flies heavily over the underwood to a short distance, and drops headlong into the first convenient bush. Towards twilight, it emerges from its concealment, and may be observed seated with great majesty on the summit of some granite boulder, on the side of a hill overlooking the surrounding jungle. Its voice is hoarse and hollow, and connected with the gloomy scene and hour in which it is heard, the repulsive laugh in which it occasionally vents its notes "*Haw, Haw, Haw, Ho!*" cannot fail to strike a fanciful listener with unpleasing associations. I met with two of this species near Sísdah in Borabhúm, probably a solitary pair, and have placed it as a new addition to the STRIX family, as it differs essentially from any yet described by PENNANT, LATHAM, or HARDWICKE, as found in India.

6. STRIX CANDIDUS, *Jungle Owl.* T. Male. From head to tail 16 inches, spread of wings 3 feet 4. Eyes black, bill and legs horny, tarsi denuded : whole upper parts shaded with dark and light brown, as in the short-eared owl, the feathers indiscriminately sprinkled with clear white spots ; primaries and tail tawny-brown, broadly barred darker, radial feathers of face, breast, belly and vent pure white. This species frequents the long grass jungle, and passes its life almost entirely on the ground, seldom perching on the lowest trees. When flushed, it rises heavily, and drops again into the grass, as suddenly as if shot. It is silent and solitary, the young keep in company some time after attaining their full growth. The jungle owl is found throughout Bengal and the upper provinces in tracts of long grass, to which it appears wholly confined. Male and female scarcely differ.

7. STRIX RADIATA. *Little barred Owl,* T. (*St. Castanoptera ?* Horse. Java.) Male. Length 7½ inches, breadth 18 ; 4th quill longest. Bill greenish horn. Eyes gold, feet and claws horny, slightly feathered to the claws. Face, head, and upper parts pale amber-brown, clearest on head, greyest on scapulars and back, the whole barred with dull sepia ; greater wing coverts black, the outer webs of the feather white mixed with rusty, edges of wing chesnut, barred brown ; alula spuria and primaries do. barred black ; edges of scapulars have greyish white patches. Tail dark coppery brown, barred pale rusty ; breast as black but paler, the brown changing to griseous white towards the belly and thighs ; the whole under parts barred dingy sepia. Very common in the thickly-wooded parts of the Jungle Mehals, selecting the largest trees for its abode, from whence it keeps up its clamorous cries the greater part of the day. It is active, frolicksome, and diurnal, and feeds on insects.

8. STRIX LUGUBRIS. *Brown Wood Owl,* T. Male. In length 12 inches, breadth 2 feet 2. Eyes gold, bill and legs horny, tarsi and toes feathered, whole upper parts dull uniform brown. Beneath whitish, barred rusty ; primaries and tail, leaden brown, barred broadly darker. Inhabits the retired parts of the thickest jungle, coming towards the edges and open parts at night. It is completely nocturnal, and in a calm moon-light night, its incessant cries are heard to a great distance, resembling strongly those of a strangling cat. The only specimen seen was killed at Dampára, in Dholbhúm.

9. Lanius Silens. *Silent Shrike,* T. 9 inches from tip of bill to tip of tail, of which tail 4. Wings spread $14\frac{1}{2}$ inches, 3rd quill longest; eyes hazle, bill and legs black, plumage iron-grey, quills darkest; upper mandible slightly notched. Young bird is marked on the under parts with indistinct transverse bars. Common. Frequenting topes and large trees.

10. Ixos Virescens ? Temminck. Male. Size of a starling. Eyes blood-red, feet and bill dark, body plump, olive-green, palest on head, where it is slightly greyish, tinged with yellow on upper tail coverts, quills and their coverts do. edged brighter green; tail as back, long, square; vent and under tail coverts, chin and base of lower mandible pale clear yellow; over the eye, and a spot on base of upper mandible, extending below the eye to the auriculars, obscure white; lower parts whitish tinged pale yellow; breast dashed with grey, bill deeply notched.

Killed in woody and barren country, at Bamireah, near Midnapur: appeared shy, silent and solitary, and partakes of the nature of the fly-catchers and thrushes. It flew and settled about the lower parts of bushes and thickets. Stomach contained berries and seeds.

11. Drongo Cœrulescens. *Fork-tailed Shrike,* Latham ? Male. Shape and size of the smaller "King Crow." Head gross, bill hooked, not notched; eyes orange-red, bill and feet black, tail deeply forked, as long as the body; whole of upper parts dull metallic-black, deepest on head, brownest on quills; chin, throat, and breast iron-grey, below sternum white. Female does not differ. Frequents high timber, and is tolerably common. Note a wild mellow whistle, pleasingly and fancifully modulated. Insectivorous.

12. Lanius Griseus. *Grey Wood Shrike,* T. Male. Length $6\frac{1}{3}$ inches, ashy-brown above, dull-white beneath; bill, eyes, and legs dark; mandible hooked, not notched; two centre feathers of tail as back, two next black, outer ones white; dark brown patch through the eyes, a white one above them, obscure brown mark from under mandible; breast tinged dusky reddish ash. Shy, solitary, rather rare, frequents saul jungle, has a jarring note.

13. Vanga Flaviventris. *Yellow Bulbul,* T. (*Lanius Melanocephalus ?* Gml. *Turdoides Atriceps.* Tem. ?) Male. Length 7 inches. Eyes pale yellow, bill black, legs dark horn. Head and a slender erectile crest glossy-black, rest of plumage olive-green above, clear olive-yellow beneath; belly and vent bright yellow, quills and tail dusty. Frequented the beautiful hanging-woods of Dampára, in Dholbhúm, where alone I met with them. Manners sprightly, hurrying from tree to tree, with a short repeated song, like the common bulbul.

14. Criniger Splendens, T. (*Irena Puella,?* Horsf. *Edolius ?* of Natterer.) The bill totally dissimilar to the *Drongo,* with which *Irena* and *Edolius* are grouped. It is long, hooked equally in both mandibles, nostrils denuded, and more like the bill of the *Chough* than any other bird. The chief peculiarity of the bird is a crest, composed of long recumbent hairs, which ride from the head and fall back on the shoulders. The tail is long, slightly forked; the ends of the outer feathers turned up, in the shape of a scoop. In other respects it resembles the *Drongo.* The plumage is deep black, reflecting purple and blue in various lights; the wings are a deep glassy-green. These birds are tolerably numerous, but confined in locality. They frequent the large timber, which luxuriates in the lower portions and richer soil of the jungles, on the banks of nullas, tanks, &c.: the cotton tree, when in blossom, is a favorite resort, where they may be seen in small parties frolicking about. The voice is very changeable and in constant exertion, from a beautiful song, to whistling, chattering, and creaking, like a rusty wheel. The notes at times resemble the higher strains of an organ, and heard in the wild and lovely scenes where this bird is found, appear singularly striking and plaintive.

15. Muscicapa Tyrannides. *Shrike-like Fly-catcher,* T. Male. Length 4 inches. Eyes orange-hazle, bill and feet black. Bill flat, broad, long, straight, hooked, not notched. Head, nape of neck, back, wings and tail, black; rump, wing coverts, and line along tertials, and a broad streak along auriculars, from base of bill, white. Breast and belly pale silvery grey. Outer tail-feather white. Killed at Sísdah in Borabhúm. Rare, frequents high timber, has a slight song.

16. Muscicapa Princeps, Cuvier; *M. Miniita.* Temmink. Rare. Indiscriminately spread through the jungles. Sometimes solitary, at others, flying in small parties. (Figured in Gould's Century of Birds.)

17. M. Hyacintha, Temmink. Size of a Robin. Male. Upper parts, wings, and tail ashy Antwerp-blue; between the eye and beak a dark space. Chin and breast buff-color, rest white. The colors are paler, but distributed not unlike those of the American blue Robin. Rare, silent, frequenting high trees: killed at Lika in Borabhúm.

18. Muscicapa Occipitalis. Common in all parts of the jungles.

19. M. Cærulia. Common.

20. M. Maculata. *Pied Fly-catcher.* Linn. Marked the same as the subject mentioned in Bewick. Rare.

21. M. Peregrinus. *Parus ?* Figured in Gould. Common in the jungles. In manners closely resembling our long-tailed titmouse. The males unite in flocks apart from the males at the close of the cold season.

22. Motacilla Sylvatica, T. Rare, shy, found in low, barren saul jungle; black, with white wing covers, small.

23. M. Luzonia. Numerous, frequenting high timber near nullas, &c. well known in Bengal as Indian Robin.

24. Turdus Macrourus, Vaillant? *Shahmour Warbler.* $9\frac{1}{2}$ inches long, of which tail 5; plumes glossy-black, tail cuneiform; outer feathers tipped white. Upper tail coverts white, lower part of breast and belly deep chesnut, eyes and belly black, legs fleshy horn. The Shahmour is well known and justly prized in India for its song, which in its native jungles is heard in a degree of perfection, to which the notes, when encaged, can bear little comparison. It is spread throughout the jungles, and haunts the deepest glades and hollows, keeping in the centre of thickets. In the grey mornings and evenings the notes are heard through the valleys, ceasing with twilight. The song of the Shahmour is fully equal in compass, power, depth and modulation to that of the Nightingale. The strains sweep with a gush of sweetness through the enchanting solitudes which this bird makes its favourite resort, at times when the other inhabitants of the forests are silent in rest. And in unison with the surrounding scenery, in which nature seems to have lavished every fantastic invention of beauty, the effect produced on the mind and ear can alone be appreciated by those who have witnessed the magnificence of a tropical forest.

25. (Motacilla Suecica, *Blue-throated Warbler.* Linn?) (*Sylvia Cyanecula*, Meyer?) Male. Size and shape of Redstart, whole upper parts dark olive-brown, feathers of the crown centered darker, with a white patch over the eyes as in Whinchat. Eyes, bill, and legs dark horn, throat cobalt. The space from thence to the sternum is divided into transverse portions of color. Uppermost a band of chesnut-brown, then one of cobalt-blue, then white, and lastly chesnut again; below this all white; on the centre of the neck, adjoining the blue and chesnut of the throat, are two confluent patches of white and dark brown. A single specimen of this elegant species was seen and killed at Bamirah near Midnapur, in wild bushy country.

26. Motacilla Calliope. *Ruby-throat Warbler,* Pallas. (*Turdus,* apud Latham and Gml.: *Accentor,* apud Temminck.) Male. Length 6 inches, plumage above olive-brown, beneath dull whitish. Band above and below eyes white, intermediate space black, feathers of throat slightly *scaly* (stiff and strongly scutellated); light scarlet with silvery edges; bill and legs horn, eyes dark. Rare, solitary, silent. Haunts thickets and underwood. Found at Dampára in Dholbhúm, and at Jehanabad, west of Hoogly.

27. M. Rubicapilla. *Rusty-crowned Warbler,* T. Female. 5 inches, eyes reddish hazle; bill and legs pale horn, crown of head rusty; feathers of nostrils, over the eyes, auriculars and sides of neck, pale yellowish green; upper parts olive, throat and breast pale yellow, shafted black. Found in the thick underwood, hollows, ravines, &c. Lively and agile, with a frequent piping note and occasional chatter.

28. M. Cantator, *Chiming Wren,* T. 4 inches. Male. Eyes hazle, upper mandible dark, lower pale orange; legs pale horn, crown black, with a longitudinal central yellow stripe; black stripe through eye and a yellow one over it; throat bright yellow, extending towards breast, lower parts lint-white, vent yellow; plumage above, clear olive-green. Frequents trees in the thickest parts of the jungle. Has a loud and incessant note, " pio, pio, pio, pio." Bill rather gross, as in Winchat, not flattened, not hooked as in Regulus, slightly notched: nostrils large, oblong, almost pervious.

29. Sylvia Longicaudata. *Long-tailed Warbler.* Gml. (*Malurus* of Veillot.) Male. 5½ inches, of which tail 2½, bill and eyes dark, legs orange-horn color. Upper parts a pale dull brown, on face ashy. Under parts satin-white; quills and coverts pale clear brown; tail ashy brown, tipped obscurely black and then whitish; wings much rounded and short; first quill almost spurious, 5th and 6th longest; tail cuneiform. All the plumage waving and flimsy in texture, scarcely any tail coverts. Common. Has a sprightly intermittent song, perching for a time on the summit of a bush and then seeking thickest underwood. Frequents barren saul jungle.

30. Motacilla Offinis. *Olive Willow Wren,* T. (*Willow Wren?*) 5½ inches. Male. Upper parts dark olivaceous ashy-brown. Beneath, brownish yellow ochre. Clear yellow streak over eye. Upper mandible dark, lower pale horn: legs horn, eyes hazle. Killed in high-timbered jungle, on the banks of a stream.

31. M. Dumeticola. *Thicket Warbler,* T. Male. Nearly 6 inches long, eyes reddish hazle, bill as former subject, legs pale fleshy horn; crown dingy rust, face and over eyes dirty whitish brown, auriculars darker. Whole of the plumage dull olive-brown, as in the thrush; tail slightly rounded, whole under parts white, streaked with the color of back, throat white. Female and male alike. Frequents the thickest foliage, at the top of high trees, and is rarely seen. Has a monotonous note, consisting of three sounds, which is heard incessantly during the morning.

32. M. Fulicata. *Sooty Warbler,* Cuvier. (Bill in no way allied to the groupe in which Cuvier has placed it.) Male. Size of a

robin. Upper parts dull dark brown; under parts, including the eye, burnished black; greater wing coverts white, next greater as back, but with a gloss of steel; tail black, vent and centre of belly chesnut, quills of wings a deep claret-brown. Frequents low bushy jungle, and has the manners of the stone chat. The bill however is cylindrical, long, thin, partially curved, not unlike that of the house wren. Bill, legs, and eyes dark.

33. M. SUBVIRIDIS, T. Male. Allied to the *M. Zeilonica* of Horsf. Bill and legs pale bluish horn, eyes hazle; plumage above olive-green, below olive-yellow; wings black, edged yellow, greater coverts tipped white, tail dark olive-green. Common in thick bambú or saul jungle, on hills.

34. TURDUS LIVIDUS. *Leaden Thrush,* T. Head and neck pale orange brown. Rest of plumage blue grey. Size of a redwing. Female rather larger and duller in plumage. Shy, silent, solitary. Frequenting thickets in rocky jungles. Killed at Lattapora, in Borabhúm. Rare.

35. T. UNICOLOR, T. Size of preceding. Female. Eyes dark, bill and legs yellow horn, plumage a dirty grey, mixed on the back with olive, tinged on the head with brown. Wings and tail brownish; coverts of tail iron-grey; breast Isabella grey, belly white. Silent. Frequents large trees. Rare. Killed at Bansíghar in Borabhúm.

36. ORIOLUS M'COSHII, T. Male. Length 9 inches. Bill, feet, and eyes black. Top of head black, each feather edged yellow; forehead yellow, throat and front of neck white, streaked black. Rest of body yellow; coverts all centered black, quills brownish black, fringed pale grey-yellow; tail centered olive, tinge of olive on back. Frequents the highest trees in open jungle cultivation, &c. Sings beautifully. (The only specimen seen.)

37. NECTERINIA SEHERIÆ, T. *(Cynniris Gouldii ?)* Male. Length 4 inches. Crown burnished copper, with green reflections. Neck, back, and breast, a deep blood carmine color. A stripe on each side the throat, from the under mandible brilliant violet; lower part of back yellow; tail coverts bright green, tail violet and green, blended with metallic lustre; quills dusky brown, belly and vent dusky; eyes, bill, and legs dark. This rare and elegant subject was procured near Seheria in Borabhúm, flitting about the low willow bushes in the dried bed of a stream. It has no song, but a shrill chirp.

38. N. MINIMA, T. Male. Length 3 inches, plumage ashy olive, paler beneath; wings and tail brown. Common in saul jungle.

39. CHLOROPSIS CÆSMARYNCHOS. *Hook-billed Chloropsis,* Jardin. Appears to be completely out of its place in Cuvier's arrangement. But

the description is scanty and ambiguous, and may possibly not refer to the present subject. Male. Length $7\frac{1}{2}$ inches. Bill as in warblers, but hooked throughout, (much, as in Certhia.) Toes, three before, one behind ; plumage parrot-green, palest beneath; throat, part of cheek, and forehead black ; a lilac spot by lower mandible, spot of bright blue on humerus ; bill black, eyes hazle, legs pale bluish horn. It has a beautiful song, and is common in the jungles, flying about in small parties. It is an excellent mocker, and imitates the notes of almost every small small bird of the country. (Frequently sold in cages at Calcutta and Monghír.)

40. Emberiza Sylvatica. *Bush Bunting,* T. Very common throughout India.

41. Loxia Bicolor. *Gobergosee Grosbeak.* T. Male. Length $4\frac{1}{2}$ inches. Bill dark bluish, eyes hazle, legs dark ; breast, belly, and part of upper tail coverts white; rest of plumage dense brown; tail black, cuneiform. Flies in small flocks, with a low piping note, frequenting sugar fields, low bushes. Fructivorous.

42. Fringilla Agilis. *Piping Finch,* T. Four inches long ; plumage ashy-olive, with grey and greener portions ; below dull white tail partially tipped white ; legs black, bill bluish, eyes orange. Perched on summits of trees. Appeared lively and agile, with a sharp clear whistle. Not uncommon.

43. Emberiza Olivacea. *Kirwa Bunting,* T. Male. Rather larger than a sparrow. Olive-brown above, obscure white beneath; feathers of head and neck centered darker ; greater coverts dark brown, tipped white ; tertials do. edged olive and tipped grey ; primaries and tail dark-brown edged olive-green; eyes hazle, bill bluish, legs flesh. In flocks, on open cultivated land.

44. Fringilla Flavicollis. *Chilliama Finch,* T. Male. Size of a sparrow, slighter, with longer bill and wings ; the same color as the hen sparrow. Lesser coverts chesnut, throat white, a patch of yellow immediately below, in front of neck.

45. Picus Guttacristatus. *Pearl-crested Woodpecker,* T. (P. *Amantius,* Horsf. Java ?) Female. Length $10\frac{1}{2}$ inches, bill $1\frac{4}{5}$; eyes amber yellow, bill blackish horn, legs pale blue, forehead dusty brown ; crest large, full, black, with round white spots ; neck white, with broad longitudinal black stripes, one through eye, two narrower from maxillary angle, confluent below auriculars, another down centre of neck; front of neck, breast and belly, marbled black and white ; tail and quills black ; back and upper tail coverts pale bright scarlet, with subterjacent white bars ; rest of upper parts and coverts deep olive-gold color.

Common. Frequenting the largest timber, cotton trees, &c. Noisy, agile.

46. P. Bengalensis, Horsf. Differing merely from the foregoing in having the crest red and the tail coverts the same as the back. Is too well known in Bengal to require description.

47. P. Aurocristatus, T. Plumage and size scarcely differ from that of the *P. Medius* of Bewick. The crest is of a golden-buff color, with the extremity scarlet; lower parts brown and white; belly scarlet. The male is $\frac{1}{3}$ larger than the female. The latter has the entire crest golden-buff. Pretty common in thick jungles. Has a squeaking monotonous note.

48. Sitta Frontalis. Swainson. *S. Velata,* Temminck. *Orthorynchus Frontalis,* Horsf. Java. Does not differ from the description given in Cuvier. Rare. The single specimen seen was procured at Kankarjurí, near Dampára in Dholbhúm. It flies and climbs about the underwood with great rapidity, and is found in the thickest parts of saul jungle.

49. Buceros Malabaricus. *Malabar Hornbill?* Male. Length of bill 7 inches; of excrescence 8; from maxillary angle to end of tail 2 feet 3, of which, tail 1 foot 1; from tip to tip of wings, 3 feet 2. Bill pale yellow, excrescence or horn black, with a broad lateral irregular line of yellow, occupying nearly the whole of it; pale, livid-fleshy patch on the base of lower mandible; eyelids ciliated, eyes scarlet; feet iron-grey, tarsi strong, thick, short, and scutellated; from sternum downwards, and all the feathers of the tail (except the two centre ones) white; rest of plumage shining metallic black.

These birds were very common in all the more open and large timbered spaces in the jungles, frequenting in preference the píepal trees, the berry of which forms their principal food. The young continue with the parent birds for many months, after leaving the nest; hence these hornbills are generally met traversing the forest in flocks of eight or ten. They are shy and wary, and the voice loud, clanging, and harsh. The horn is not developed till after the first year, the nestlings having the bill plain and without any trace of excrescence. These birds are never met with in the high rocky lands, nor in the barren tracts of saul jungle, but abound in the rich meadows composing the valley of the Subonrika, where the country in many parts has the appearance of a well-cultured English park.

50. B. Gingianus. *Gingi Hornbill.* Very common in the same haunts as the foregoing, and well known throughout India.

51. Bucco Linrata. *Hackled Barbet,* T. Male. Length 9 inches; shape and manners of *B. Lathami,* (the well known green species.) Bill

and base space round eyes orange; eyes grey, feet horn; head and neck as far as breast, and back, brown with light shafts; the feathers narrow and pointed; rest bright green, pale on belly.

52. TROGON DUVAUCELII. Duvaucel's *Curucui*, Vaillant. This most elegant subject is described in Cuvier. The solitary specimen seen was killed near Dampára, Dholbhúm. It frequents the thickest jungle at the bottom of ravines and dried rocky nalas, flying from tree to tree, with a wild querulous note, like the mewing of a cat. It pursues and catches insects on the wing, like the Muscicapæ: the stomach of the present specimen was crammed with them. The bright and glowing colors of this bird seem little suited to the gloomy depths which are its resort. Those abodes of everlasting shade, where the meridian sun barely penetrates, overhanging arches of vegetation, and which are inhabited by undisturbed flocks of bats, owls, and night-jars, afford a striking exception to the general rules of nature, which has clothed in sombre garbs "the birds that shun the light," by harbouring so beautiful a tenant as the *Curucui*.

53. CAPRIMULGUS ALBONOTATUS. *Dampára Night-jar*, T. Male and female alike, larger than the common English night-jar, which it closely resembles; the plumage is greyer however, and it is distinguished by a large patch of white on the neck, two or three on the tertials, and on the outer feathers of the tail. It is extremely common in the jungles, keeping in thickets during the day, and coming out as evening sets in, to the open parts, grass plains, and *khéts*, which it skims over with a low silent flight. When on the wing it emits a low chirp, something like a sparrow. It has another and very peculiar note, when seated on the top of some decayed tree, and which on a calm night may be heard for a mile, sounding as if some one was striking a plank with a hammer deliberately.

54. HIRUNDO CORONATA. *Dhudka Swallow*, T. (*H. Cristata* of Le Vaillant?) Male. Length 8 inches, 1 ft. 1 across the wings; cheeks and base of lower mandible chesnut; from eye to bill, black space; head adorned with a pointed, erectile crest, of a bluish clear grey, as are the upper parts; breast and belly do. paler; wings and tail glossy black with green reflections; eyes, legs, and bill dark. The female has a smaller crest, and instead of the chesnut mark on the face, a black patch, bordered below with a white line. They fly in large flocks, but are partially met with hovering over the marshy spaces in the jungles. The note resembles the monotonous "*kia, kia*" of the parrot. They disappear in those regions by the end of March, but I never could trace the direction of their flight.

55. Columba Sylvatica. *Great Jungle-Pigeon*, T. Length 13 inches. Eyes orange, feet rose-color, bill horny, bluish over the nostrils; head, breast, belly, a pale violaceous grey, with vinous tints; upper parts, wings, and tail, brilliant changeable-green, with purple and coppery reflections. Common in some parts. Preferring the open and large-timbered tracts. Wild and difficult of approach. They go generally in small parties of four or five. The voice is deep, and resembles groans. Sexes alike.

56. C. Agricola. *Foxy-Pigeon*, T. Male. Length 11 inches; eyes orange; bill and feet lake; head, neck, and breast reddish vinous brown; forehead and belly ashy blue; back, coverts, and quills vinous chesnut, each feather centred dark brown; upper tail coverts iron-blue grey; tail dark-clouded brown, patch of black; white-edged feathers on each side the neck. Met with in open cultivated parts. Shy and difficult of approach.

57. C. Javanica. *Java Turtle?* Male. Length 8 inches; tarsi elongated as in the ground-turtle, nevertheless perches; tail short, rounded, fourth quill of primaries longest; crown, pale ashy-lilac, which extends along the back of the neck to the back; white patch over eyes, enclosing forehead; rest of head, neck, breast, and belly vinous-grey, with a rosy blush; some of the feathers of the back black, edged green; lower down a broad bar of brown, edged black and white above and below; upper tail coverts blue-grey, primaries dusky-brown; the rest of wings a deep brilliant green, flashing gold in various lights; tail black, outer feathers white with black tip; bill red, tipped black, eyes black, legs flesh-color. This most elegant and diminutive species haunts the most impervious parts of the jungle, and is seldom seen except in the cool of evening, when it repairs to the open parts of streams and meadows. Two specimens alone seen in the Jungle Mehals, one of which, the female, differed merely in having the green of the wings tarnished with copper.

58. The Stone or Norfolk Plover of Bewick, abounds in every open tract in the jungles, coming out to feed at night.

59. Rallus Javanicus, T. (*Gallinula Javanica*, Horsf, Java.) Male. Size and shape of the Parra ænea; the claws however as in Gallinula. Eyes blood-red; bill pale green, with orange-colored ridge; nostrils pervious; whole upper parts, quills, and tail plain black, with greenish reflections on the coverts; belly, vent, under tail-coverts, dusky-red; inside of thighs dirty white, outside chesnut and dark-grey, legs dusky. A solitary specimen seen at Tumchararаro, in Borabhúm. Had the same haunts and manners as the common Parra of Bengal.

60. Parra Arata, T. Male. Size and shape of P. ænea. Eyes dark hazle; bill greenish horn, upper mandible darker, nostrils pervious; a flap of detached skin on the forehead, crown deep bay or dark chesnut; eyebrows light, face white; from the back of the head, along the nape of the neck, glossy purple-black, changing to lake and coppery purple towards back; throat and narrow strip in front, extending to middle of neck, white; rest of neck and breast pale buff; belly and vent white; back cupreous olive-green; upper tail coverts and tail a burnt copperish lake; primary and secondary quills black; tertials as back, partly fringed white; greater coverts black, smaller coverts and scapulars as back; outer side of thighs, black and white radiated; inner white, flanks black. Pretty common, in small marshy pools, overgrown with jungle.

A great variety of birds in addition to these, met with in the Jungle Mehals, might be added to the list already enumerated; but as they are indigenous to the whole or various parts of Hindustan, and have been described by former collectors, their insertion here would be a useless repetition. Ornithological research, which has made such extensive progress into the heart of America, Africa, and the comparatively unknown regions of Australia, has as yet had little insight into the productions of this country. especially in those parts which have not been more immediately located by Europeans. Many of the most rare and beautiful birds, inhabiting the Himálaya mountains and the adjoining forest in the Teraye, have been brought into notice by the talents and spirited researches of one or two gentlemen; but even supposing their exertions would make us eventually acquainted with every species found in those immense tracts, there yet would be left a wide blank in our acquisitions, so long as the extensive, unknown, and unvisited portions of the Jungleterry districts remained shut out from the inquiries of the naturalist. These regions, placed in a sensibly warmer latitude than the Nipal forest;—differing in soil, in altitude, in vegetable productions;—presenting ever to the eye an altered, a peculiar, appearance of scenery;—rendered in parts uninhabitable even to the half-humanized denizens of the jungles, from the influence of pestiferous exhalations, issuing more or less throughout the year from abysses, overgrown by rank vegetation, where the light of day seldom enters, and the cadaverous weeds, fixed in a stagnant atmosphere, never wave in the refreshing breeze;—afford asylums to the rarer and wilder animals of the forests, which few or no human footsteps have invaded. The Trogon or Curucui (No. 52), hitherto asserted as belonging alone to the interior of Africa, has been found here. The Hippopotamus, also exclusively consigned to Africa, Fossil jawbone of an Elephant found near Jabalpur

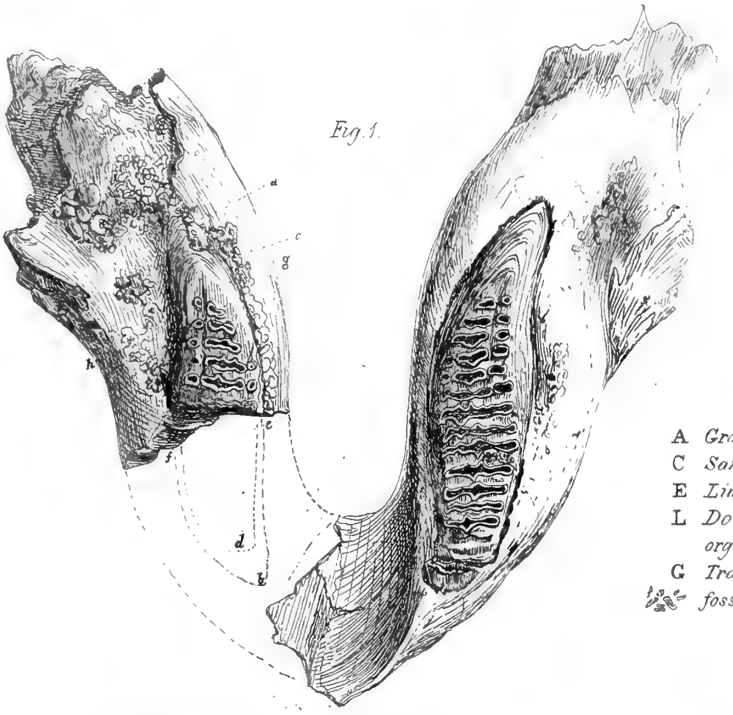
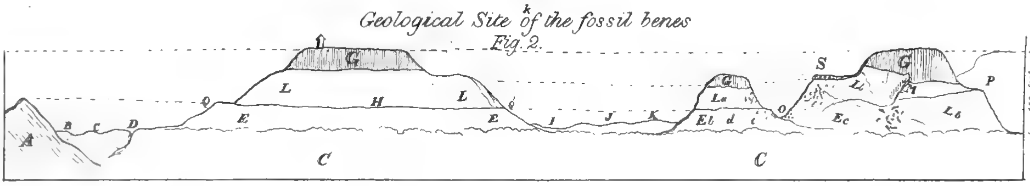



Fig. 1.

Dimensions
a b ...... 11 1/2 inches
c d ..... 8 1/2
e f ...... 3 1/2
g h 6
girth gh 24 in

A Granite
C Sandstone
E Limestone
L Do with organic remains
G Trap
fossil bones

Geological Site of the fossil bones
Fig. 2.




Silicified fossil shell from 18 miles east of Jabalpur (p. 205)

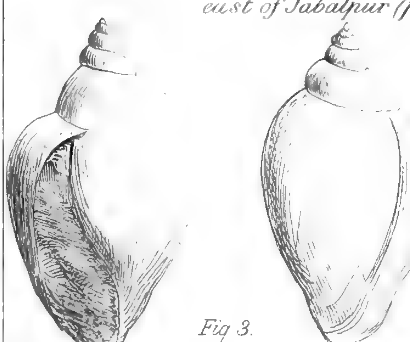


Fig 3.

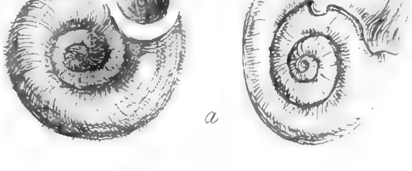
Fig. 4.

Voyseys fossil shell (see p. 94)

Fig 5.

Recent Land shells from Silhet

Fig 6



a

Spiraculum hispidum

Fig. 7

b

Spiraculum parvum

has been met with in the portion of jungle which extends into the Bhi̇l country*. The Gour, a species of bull, which by its description (as taken from a young one) must be the noblest in appearance of all known animals, ranges the hilly portions of the jungles, defying pursuit. A snake, which by the testimony (exaggerated doubtless) of the natives, must equal in dimensions the pythons of antiquity, inhabits the low marshy recesses of the jungle. A flying squirrel, hitherto undescribed, is tolerably common; and lastly, from a casual glance I once caught of an animal, in the thick and high woods bordering the Gurum nala, near the valley of the Subonri̇ka, it would be the corroboration of an anxious surmise, were after researches to establish the fact, that the *Orang Otang* is an inhabitant of these forests.

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## V.—*Note on the Fossil Bones discovered near Jabálpur.* *By* J. Prinsep, *Sec. As. Soc.*

[*Read at the Meeting of the* 30*th October.*]

The last despatch from our zealous and disinterested contributor Doctor Spilsbury puts it in our power to speak with some degree of precision of the nature of the fossil remains discovered by Captain Sleeman, and followed up by himself, in the neighbourhood of Jabálpur—a field, it must be remembered, that had been passed over by Captain Franklin and other geologists without any suspicion of the existence of such treasures.

The despatch I allude to consists of a classified series of specimens of the strata wherein the bones were found imbedded, with references to a rough vertical section of the country. (Pl. xx. fig. 2.)

We observe that the low plains covered with jungle, at the foot of the hills in question, consist of sandstone lying upon granite, which protrudes in several places, as at A A A. towards the town.

Above the sandstone lies a conformable stratum of compact silicious limestone, which on solution in acids proves to be composed of grains of clear silex, united together by carbonate of lime, here and there tinged with chlorite, or holding nodules of that mineral imbedded; at other places, passing into pure quartz, and jasper conglomerate: no stratification is perceptible in the limestone, which seems rather to bear the character of a tufaceous deposit. At one place, E *c*, an oval

* I have been credibly informed of this, by several who witnessed the animals at a distance, and afterwards examined their foot-marks (their surmises being corroborated by the natives of the country.)

concretion is enclosed, which resembles a seed or almond :—it is filled with green earth.

Towards the southernmost hill this rock contains bones imbedded in its substance, and having that pink colour observed in the first specimen sent to the Society; they are accompanied with water-worn pebbles and chlorite.

Half way up the same rock, of which Dr. SPILSBURY represents a clear section to be open to view from Q to P, a platform (Q P) exists, varying in breadth from five to twelve yards. This Mr. LYELL would explain to indicate (as the rock above and below is of the same quality) the existence of an ancient coast, worn away by the gradual action of water before the level of the latter was depressed: another partial ledge occurs on the surface of the silicious limestone, marking an anterior water line, when only the superincumbent beds were exposed to the corroding action of the sea or lake. It was upon this ledge in the southernmost hill that the first bones were discovered, imbedded in a gravel or alluvial conglomerate.

The uppermost rock is a flœtz trap, or horizontal bed of compact volcanic basalt, which must have been spread over the whole surface long before the denudating causes began to prevail, though posterior to the existence of the animals whose bones are imbedded in the subjacent rock at L *b*; unless indeed it should turn out that the breccia containing them occurs only in exterior patches, formed of their detritus, and containing also portions of the basalt, which one or two of the specimens whose labels are lost seems to render probable.

Of the nature of the bones found imbedded at L *b*, and of the period in the history of the globe to which they belong, the imperfect broken state of the fragments precludes us from pronouncing any opinion. Fortunately, however, Dr. Spilsbury's discoveries did not stop here; as he correctly observes himself in one of his letters, one discovery has gradually led to another, and he has become a geologist in spite of himself, by the force of accidental circumstances, and the intense interest which such discoveries are calculated to awaken in the mind of man. "A notice is inserted as a hint in the Journal, that fossil bones may be met with near Jabálpur :—" I am put on the qui vive—set out for the hills and bring in a collection of specimens :—my people perceive my curiosity, and bring me in any thing uncommon they meet with :—I go to Brimhan Ghat, whither the European residents have constantly resorted for years past, and the moment my mahout sees a huge bone, he brings it to me, and it is discovered to be an elephant's jaw-bone in a perfect state of preservation." A Fakír it seems had occasion to pull down and rebuild his hut, near the banks of the Nerbudda, when in the foundation these curious reliques were found and thrown aside. "So again," says Dr. S. "some four months ago, a little boy tells me of a wonderful skeleton, said by the natives to be that of a giant, describing the fingers as a foot long: a *patĕl* has a *kneepan* that serves for a scale to weigh 3 or 4 seers of cotton in;—'is not this,' says the boy, 'as wonderful as your jawbone?' to this I readily assented, determined at any rate to sift the rumour. It was stated to be in Captain Garstin's district in the *Omar Nadí*, about two kos (9 miles) from *Narsinhpur* (Garawára). I applied to Captain Garstin, who, owing to the rains, was only two or three days ago able to send me in a specimen. I suspect it will turn out to be a fossil elephant, but I shall be better able to speak on the subject when I have visited the spot on my way to *Narsinhpur* a few days hence."

Thus are our eyes at once opening to an unexpected and most interesting object of geological research. Upon the first inspection of the fragments the question naturally arises, to what animal do they belong, and to what species? as it may be remembered that all the fossil mammalia discovered in the tertiary deposits of Europe and America, and even those brought away by Mr. Crauford from Ava, have been pronounced to belong to extinct species by the most competent authority, and generally on the unequivocal testimony of skeletons, nearly complete, if not perfect. It would be rather hazardous therefore to pronounce upon the single half jaw-bone* before us, that the Jabalpur fossil elephant was an exception to the general rule; yet, upon comparing the specimen, side by side, with a recent skeleton in the Society's museum, it is impossible to discover any such distinction as should constitute a difference of species: it is in all respects of the Asiatic type of elephant, and can be confidently distinguished from the *elephas primigenius* of Cuvier, so common in Germany and throughout Asiatic Russia, which has itself been pronounced "more different from the Indian species than the ass is from the horse, or the chacal from the wolf and fox."—*Pidgeon's Fossil Remains*, 59.

I hope that the accompanying drawing will enable more experienced geologists to decide the question of the identity of the specimen with the existing species of elephant; for although it may thus lose in antiquity, it may perhaps gain in value, as an intervening link between the inhabitants of our planet in two geological periods now separated by so strong a barrier of dissimilar organization.

* Part of the opposite jaw has been since received, and has been added to the drawing. (Pl. XX. Fig. 1.) They are both inverted in the engraving.

While committing the foregoing notice to press, I have received the following account from Doctor Spilsbury, confirming the expectation alluded to in his former private communication. J. P.

*Account of the Fossil bones discovered in the bed of the Omar Nadí, near Narsinhpúr or Garawara, in the Valley of the Nerbadda. By* G. G. Spilsbury, *Surgeon to the Nerbudda Commission, &c.*

Some months ago a native report reached me, that in a nala of the *Narsinhpúr* district the skeleton of a giant was to be seen, the fingers of which were said to be three feet long, and that a kneepan served as a weight of five seers to the *patel* of the village. On hearing this I applied to Mr. Garstin, the magistrate of the district, requesting him to inquire into the truth of the story: that gentleman immediately with his accustomed kindness sent out and procured some specimens, which he forwarded to me at Jabalpur. Finding they were fossil bones, I made arrangements for visiting the spot in person, and beg to forward the accompanying specimens and plan of the place.

At the spot marked A a, (Pl. XXI. fig. 1.) the water had worn away much of the stone, at the under side of which I could perceive a large bone. By the aid of villagers, and digging all round, I was able to upset this stone, under which imbedded lay a thigh-bone five feet three inches long*, quite perfect from the round head to the condyles, and altogether a most magnificent specimen: in turning over the stone, however, it was split into two pieces, and the bone fractured about two feet from the condyles. A is the general rock found in the bed of the river,—B portion from that in the stream—b c, spots where large fragments of bones (one apparently the condyles of a similar thigh-bone) were lying. In the dry bed of the nalla are strewed nodules of which the accompanying is a specimen, and generally about that size. I send a small tooth (fig. 3) which I picked up between A a and the fossil imbedded in the cliff. The tradition of the village is, that the head of this animal was washed down the river some sixty or seventy years ago. I obtained one large tooth from the Thakúr of Omarín; this, together with five specimens, I hope at a future opportunity to submit to the notice of the Society.

*Description of Plate* XX. *illustrative of the Jabalpur fossils.*

*Fig* 1. Represents a superficial view of the two fragments of the fossil bone, placed as forming parts of the same lower jawbone of the elephant, which on comparison with the plate in Cuvier or Griffiths will be found not to differ materially from the type of the Asiatic species. The central connecting part is represented too broad. The surface of the bone is in many places, and especially in the cavities, covered with small granitic gravel, cemented with lime. On dissolving a portion of the bone in acid, a fibrous skeleton remains of silicious matter, which has occupied by infiltration the place of the animal matter: the ivory of the tooth dissolves without residue. The dimensions of the tooth as shewn on the plate are, in length 11½

* Diameter of the bone about the middle and its smallest cylinder nearly six inches.

inches: breadth, $3\frac{1}{2}$ in.: grinding surface $8\frac{1}{2}$, by 3 in.: girth of the jaw-bone, 24 inches, and probable length from K, the apex of the chin, to the socket, 26 inches.

*Fig* 2. Represents a geological section of the insulated hills to the east of the line joining the cantonments and the town, distant $1\frac{1}{2}$ miles. The letters refer to the specimens sent down by Doctor Spilsbury.

A. Granitic hills to the north, extending to the town, where they dip, and rise again near Garrah ; white quartz and felspar, dark grey mica.

B. Smaller grained granite, decomposing.

C. Granitic sandstone, friable, fine grained.

D. (From a watercourse), ferruginous sandstone, shewing the action of fire. Between D and E, veins of quartz protrude.

The loose sandstone is stated to form the whole surface of the plain, covered with low jungle at the foot of the hills, intersected with ravines. In it, half way between the residency and the city, was found the specimen of silicified wood, formerly presented.

At I and K seams or beds of fine potter's clay are found: at J the sandstone is quartzy, ferruginous, and friable.

EE is a compact silicious limestone, containing crystals of calcareous spar, shell impressions (?) and amygdaloidal concretions filled with chlorite, which have the appearance of fossil seeds. At E*c* E*d* it incloses quartz pebbles, and fragments of bone mixed up with green earth, and apparently incorporated with the substance of the rock: in some places the limestone passes into quartz. On solution in acid, it leaves a fine clean sharp angular quartz sand.

Captain Franklin describes a calcareous conglomerate near Jabalpur as composed of rounded fragments of wacken, basalt, sandstone, quartz, and fine sand, cemented by calcareous matter, and resembling calcareous sandstone. Its stratification is always horizontal, and it occurs in the beds of most rivers whose sources are in trap countries: he supposes it to be formed from the detritus of sandstone and overlying rocks, reposing on primitive rocks, and covered with 30 feet of alluvium; but it is doubtful whether his account includes the present rock, which seems to extend for a great distance in each direction underlying the basaltic trap.

From Q to P occurs the ledge in this rock before noticed, marking the former position of a coast. At O, a small water course between other hills, is a conglomerate containing pebbles of red jasper, basalt, felspar, &c. united with silicious cement. At H a similar variety occurs, and veins of brown silex are frequent in the limestone.

Above the ledge L is a continuation of the same limestone, which towards L*a* becomes a bone breccia, and at L*b* is much broken and mixed, from the protrusion of a basaltic vein at M. S is the platform covered with a kind of gravel, on which Captain Sleeman first discovered the fossil bones: it was evidently part of the lacustrine bed previous to the denudation of the lower valleys and the present Nerbadda plain.

G is a stratum of compact basalt, conformably stratified and overlying the limestone on the three hills, whence it may be concluded to have been once continuous over the whole space. The sketch does not pretend to accuracy, but the height of the hill to the right is stated in round terms to be 150 feet. It would be a profitable employment for a geologist to strike a complete section across from the trap hills S. E. of Jabalpur to the sandstone range of *Pataria*, and another from *Tendukaira* to the hills south of *Narsinhpúr*, sounding through the alluvium of the valley of the Nerbadda, and so putting us in possession of the true features of this field, now becoming every day more important from the discovery of its coal, fossil wood, shells, and animals.

*Description of Plate* XXI. *the locality of the Narsinhpur Fossil Bones.*

*Fig* 1, the section of the bank laid bare by the gradual action of the *Omar Nadí* exhibits; first, an inclined plane, C D, marking the limit of the rise and fall of the stream, about 12 feet. Above this the bank is exposed for 25 or 30 feet in height between two ravines, which, and the surface, are covered with thick jungle. The upper part of the bank is composed of a light soil, mixed with kankar, and a number of globular kankar nodules are found in the bed of the stream, containing silicious nuclei.

A A, the rock in which the bones are imbedded, is a gravelly concrete, formed of rounded pebbles, grains of quartz, jasper, and basalt, united into a hard rock, with calcareous cement: it seems to agree with Captain Franklin's rock, which may thus prove very fertile in organic remains, while it must also be of great extent in the valley of the Nerbadda.

*Fig.* 2, the plan of the locality requires no explanation.

*Fig.* 3, is the fossil tooth alluded to in Dr. Spilsbury's note. This tooth, according to Mr. Pearson, is the third molar of the left side of the lower jaw of a horse, and it agrees with other fossil bones of horses in being a little smaller perhaps than the present species, but it is impossible to judge from a single bone. Fossil remains of horses are common enough along with those of the elephant, elasmotherium, hog, &c.

An elephant 14 feet in height will, according to Cuvier, have a thigh-bone 5 feet in length. It is doubtful whether any Indian elephant has been seen of that height.

P.

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## VI.—*Report on a Collection of Objects of Natural History. By the Curator of the Museum of the Asiatic Society.*

[*Read 30th October*, 1833.]

A valuable collection of objects of natural history having been offered for sale for Rs. 200, it was thought advisable to purchase them for the Society's museum, with the intention of disposing of the numerous duplicates to private collectors in exchange for other specimens.

Owing to the sad state in which the insects were brought, and the trouble of cleaning them, time has not been allowed to do more than put them on the table for the Society's inspection this evening, without any attempt having been made at arrangement: the same reasons apply to the shells; and will, it is hoped, be a sufficient excuse for the dromiscuous manner in which they are placed.

Locality of the Narsinhpur Fossil Bones.

Fig 1.


Fig 2


On the very cursory inspection, however, which has been made, it appears that there are several new forms, both of the insects, and of the shells. Of the former, among the Coleoptera, the specimens of the families, of which *Lucanus*, *Cerambyx*, and *Curculionidæ* are the types, are numerous; and some of the species very extraordinary and beautiful: of the Lamellicorn Beetles, there are but few, consisting chiefly of the *Cetoniadæ* and *Dynastidæ*: of the Serricornes, *Buprestis* and *Elater* are the only genera; whilst the collection is remarkable for the few specimens of that numerous family comprising the genus *Carabus* of Linnæus.

Of Orthoptera, the species are few; but among them are two specimens, unfortunately both mutilated, of the celebrated leaf insect from Sylhet.

The Hemiptera are numerous, consisting chiefly of *Pentatoma* and its affinities.

Of the order Omoptera, the genus *Cicada* and its affinities have many specimens, some of which appear to be new.

The Lepidoptera are all more or less injured. Some of the butterflies, however, are very beautiful, and may be preserved until better specimens shall be procured. The same may be said of the moths: and there are some species of the genus *Atlas*, one of which is of large size being $9\frac{3}{4}$ inches from tip to tip of the wings; and another, believed to be as yet unknown.

The collection of shells consists chiefly of the Phytiphagous section of the Trachelipodous Mollusca; some few belong to the Zoophagous section of the same order; one genus comes under the class Conchifera, and one is placed in the section Hydrobranchiæ of the Gasteropoda. In all there are about 22 different genera; and at least 60 different species, comprehending between 6 and 7 thousand individual specimens.

Among these, some of the species of *Caracolla*, *Cyclostoma*, *Melania*, and *Paludina* are especially remarkable. There is also one species entirely new, of a genus first described by Mr. Benson in the first number of the Journal of the Asiatic Society, for January 1833, under the name of *Pterocyclos*. It has been thought proper to change that name to *Spiraculum*, for reasons which are fully detailed in a paper the author has the honour of presenting to the Society to night.

In conclusion, it may be remarked, that the collection is one sufficiently interesting and valuable, perhaps, to secure a vote of indemnity for purchasing it. It is probable that on inquiry it will be found to contain many new forms, particularly among the shells: for, not possessing the kind of beauty that makes them estimable to ordinary collectors, land and fresh water shells have rarely formed any considerable part of cabinets made for shew or for sale, and are accordingly little known to, and much valued by, the naturalist.

VII.—*Note on the Genus Spiraculum. By* J. T. Pearson, *Curator As. Soc.*

[*Presented to the Asiatic Society, and read* 30*th October*, 1833.]

Class, Mollusca. Order, Trachelipoda.
Section, *Phytiphaga*. Family, ——— ?
Genus, *Spiraculum*.

*Animal*—unknown.

*Shell*—discoidal, upper surface plano-convex, almost flat at the top, largely umbilicated; whorls cylindrical; mouth circular; lip thickened, reflected; last whorl a little bent downward toward the umbilicus; a shelly, projecting spiracle, or breathing-tube on the upper edge of the body whorl, where that whorl touches the preceding one.

*Operculum* horny; very thick; formed of several spiral layers.

A species of this genus having been found by Mr. Benson, on the Rájmahal hills, he formed a new genus for its reception; and described both its generic and specific characters, so far as he knew them, in the first number of the Journal of the Asiatic Society. To this new genus he gave the name *Pterocyclos,* and that he was right in venturing to institute it can hardly be doubted, when its strongly marked characters are considered fully. But the discovery of another species, with additional generic characters, has rendered improper a name taken from the form of the aperture of a young specimen merely, or from a species, as it would appear, far removed from the typical one of the genus. Mr. Benson's name, therefore, has been altered to that of *Spiraculum,* and the genus, according to characters it is now known to possess, differs from all shells that have hitherto come to the notice of the naturalist. No land shell besides it, excepting the genus *Cyclostoma,* has a circular aperture; and it is a curious fact, that, in the genus *Haliotis* only, is there any process at all analogous to the shelly tube which form so remarkable a feature in the generic character of *Spiraculum.*

For the use of this tube analogy must be resorted to in the absence of proof; and analogy justifies the supposition of its being intended for the purpose of protecting the breathing organs of the animal; while it admits of the free passage of air when the mouth of the shell is closed by the operculum. Why it should be so; why this genus, which seems to be allied closely to the second division of the *Colimacés,* near to *Cyclostoma,* should have such an apparatus, while *Cyclostoma* has nothing of the kind, though the operculum of the latter shuts up the shell as completely as can that of the former, it is not easy to say. But it is equally difficult to account for the above-mentioned genus

*Haliotis* being furnished with tubes or spiracles well known as so many passages for a syphon; while *Stomatella* and *Stomatia,* which in other respects so much resemble it, have none.

And yet a mere breathing hole would scarcely require to be protected by a tubular process. But there may be attached to the neck of the animal of *Spiraculum,* an apparatus similar to that described by Lamarck as possessed by the genus *Valvata* of his Péristomiens;—" un filet branchial et tentaculiforme au côté droit du cou, et quelque-fois une branchie en plumet et contractile, qu'il fait sailler hors de sa cavité :" or a projecting syphon, such as carries on the respiration of the second section of the *Trachelipoda.* Thus there would be an animal breathing air yet furnished with the apparatus, or a modification of the apparatus of one inhabiting and breathing only water, and consequently occupying an intermediate place in the chain of affinity, and forming an inosculation between the two. If so Lamarck might have adduced it, had it been known to him, as another fact, strongly confirmative of his celebrated idea of the gradual perfection of the animal form. His remarks on the subject are so apposite, that they deserve to be quoted entire. " A mesure que," says Lamarck, " les animaux se repandirent partout de proche en proche, il parait que ceux des trachelipodes fluviatiles que habitèrent les eaux qui ont peu de profondeur, comme celles des petites rivières des étangs, et des marais, que sont exposées à tarir, furent souvent réduits à vivre dans une vase plus au moins desséchée. Ils se trouverent donc forcés à s'habituer à l'air, á le respirer. Or cette habitude ayant modifié leurs branchies, comme celles des colimacés, est devenu pour eux une nécessité ; en sorte que quoique vivant dans l'eau ils sont maintenant obligés de venir de temps en temps à sa surface pour y respirer l'air libre." If any change of this kind ever did take place, it may perhaps be found at some future time, when physiological investigations are better understood than at present, that these animals are able to breathe both air and water; and further, should the above conjecture as to the respiratory apparatus of Spiraculum prove to be correct, there will be another link of union between the second section of Colimaceés and the Péristomiens beside that of the Lymnéens.

Genus, *Spiraculum.* Species, *Hispidum.*

Specific Characters. Animal unknown.

Shell white, subdiaphonous, upper surface of the body whorl slightly patched with rufous. Epidermis dark-brown, covered with short bristly hairs, which at the outer and under side of the whorl are placed thickly together, giving an appearance to the shell of its being zoned with three narrow dark lines; whorls five, breathing tube one line in length, conical, compressed, pointing backward and inward; mouth circular, lip thickened and reflected. Diameter one inch.

Operculum corneous, formed of several spiral layers, deeply cupped at the outer surface, and plano-convex at the inner.

All the specimens of this collection have the mouth dilated at the upper margin into a surface more or less flat, or concave, or formed like a sinus. But in the above description it is assumed to be circular, because it is almost of that form in the more advanced specimens, from the dilatation having become a well-marked sinus, and in one or two nearly formed into a tube. In a smaller species also, in the collection, the tube is actually formed in this manner, being at first a dilatation, then a sinus, as fresh shelly matter is deposited, and finally a tube: and in proof of this, a series of specimens may be seen in the collection, in which are gradual changes from a slight dilatation of the upper margin of the aperture, to the perfect tube and circular reflected lip.

2.—*Spiraculum Parvum.*

Shell white, subdiaphonous, zoned with a dark-brown line along the circumference of the whorl, striated above with brown zig-zag striæ, and less distinctly so below. Shelly spiracle or breathing tube situated near to the mouth. Mouth perfectly circular; lip thickened and reflected, umbilicus largely dilated, upper surface plano-convex, almost flat. Diameter $\frac{6}{10}$ of an inch.

Operculum unknown, supposed to resemble that of *S. Hispidum.*

Epidermis dark-brown.

3.—The shell described by Mr. Benson under the name of *Pterocyclos rupestris.*

It is thus ascertained that there are at least three species of this interesting genus, and it is hoped that the reasons detailed above are an excuse sufficient for changing the name bestowed upon it by Mr. Benson; at all events, it has been done from a sincere conviction of its necessity, and not from any spirit of innovation.

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## VIII.—*On the Kukumb ka Tel, or Concrete Oil of the Wild Mangosteen.*

To the Editor of the Journal of the Asiatic Society.

Sir,

The motto on the title page of your Journal induces me to send you a few remarks on a substance which I have reason to think possesses some very peculiar properties, which entitle it to be made the subject of experimental investigation.

This substance is the *Kukumb ka Tel* of the natives of this part of the country, or the concrete oil of the wild mangosteen, a tree which is common in some parts of the Southern Konkan. I am not aware, whether any or what difference, further than may be induced by cultivation, exists between the above and the much-extolled mangosteen of the Straits. The fruit ripens in April and May; is small, and of a flattened globular form. The rind or shell is about $\frac{1}{8}$th of an inch in thickness, of a deep crimson colour, and intense acidity. Within this, but without adhering to it, is contained a pulpy mass, in which the seeds are imbedded. The oil is extracted from the seeds by boiling. They are first exposed for some days in the sun to dry, and then pounded and boiled in water: the oil collects on the surface, and on cooling concretes into a solid cake. When purified from extraneous matter, the product is of a rather brittle quality; of a pale yellowish hue, the shade inclining to green; exceedingly mild and bland to the taste, melting in the mouth like butter, and impressing a sensation of cold on the tongue, not unlike what is experienced on allowing a particle of nitre to dissolve on the tongue.

From several experiments on this substance with the thermometer I have been led to the conclusion that in passing from the concrete to a fluid state, and conversely from a fluid to the concrete form, it is guided by some peculiar law, in consequence of which it has two distinct temperatures, removed from each other by several degrees, at which it passes respectively from one state into the other. I need not here detail the numerous trials I made on it, as the general result was the same in all. My first object was to ascertain the temperature at which it congealed or passed into the concrete form. This from repeated trials I invariably found to be about 90°. In one instance, having brought the substance into a perfect state of fluidity, I placed it in an oven with a temperature at first above 100°, but allowed gradually to descend. When the Thermometer, which was placed beside it, indicated 88°, I expected to have found it congealed; but perceiving that it still retained its fluidity, I took it out and plnnged the bulb of the thermometer into it. The thermometer immediately rose to 94°, at which it continued for some minutes, (the external air at the time being 72°,) and then gradually descended to 90°, at which it became stationary for some minutes before the substance began to lose its fluidity and transparency: then without indicating any change of temperature, the process of congealing commenced at the sides of the vessel, the opaque cloud slowly creeping in towards the centre, and the thermometer all the while remaining at 09°.

The result of various trials satisfied me, that this substance could not be brought to congeal at a higher temperature than 90°; but in experimenting on it in the solid state, that temperature was found quite insufficient, by several degrees, again to liquify it. The following is a brief statement of the result of several trials to ascertain its melting point. It was subjected to a gradually increasing temperature, commencing from 90°, with considerable intervals between every higher accession of temperature, to allow time for the effect which was capable of being produced on it. From 90 to 100°, the effect was merely to soften it: at 102°, it still preserved its cohesion, but the consistency was that of butter in warm weather: at 106 part began to separate in a semifluid state, transparent at the edge and opaque in the centre; and a few minute globules were separately observed in a perfectly fluid state. Every fresh accession of temperature had of course the effect of bringing it more and more towards a state of fluidity; but up to 116°, there was still observable a partial opacity, and it was only when the temperature had reached about 120°, that it could be said to have attained perfect fluidity and transparency*.

Another peculiarity in this substance is the irregular form its surface is thrown into in the act of concreting. Nor does it appear capable of being prevented by any management, or by conducting the process in the most gradual and gentle manner. But the effect may be considerably increased by exposing it in a fluid state to the sudden application of a cooling medium. Having a stratum of the fluid oil at 120°, floating on water in a small cup, I suddenly exposed it to the chilling influence of a slight drizzling rain and sharp breeze, the temperature of the air being 70°: the rapid abstraction of heat soon caused the congealing process to commence, and the entire surface shot up into a series of prismatic or columnar masses, about $\frac{1}{8}$th inch in height, and separated from each other by small intervals. This effect took place some time before the substance became perfectly opaque; and while in this state, it had the appearance of a crystallized body, in an intermediate state between opacity and transparency, of which we have a familiar instance in a piece of loaf-sugar dipped in water.

The concrete oil of the mangosteen might I apprehend be advantageously introduced into pharmaceutical preparations. It is used by the natives as a healing application. I have noticed among its sensible properties, that it impresses a sensation of cold on the tongue; from which it would appear, that it powerfully absorbs heat, as several salts do in the act of dissolving. It is easy to conceive that this

* The same peculiarity is observable, more or less, in all the concrete oils: it is probably owing to their bad conducting power.—Ed.

property may often be of great service in wounds or sores, accompanied with inflammation, which it is desirable to abate.

The quantity of the concrete oil that may be obtained from the seeds may be taken at about one-tenth. From ½ lb. avoirdupois or 3,500 grs. of the seeds, I obtained 360 grs. of the concrete oil in a moderately pure state. The above is somewhat more than 1-10th; and with better management, the product might perhaps be greater. It requires however long-continued boiling to extract it, and it is still more tedious to purify it from the fibrous matter of the seeds.

*Western Ghauts, 25th September,* 1833. N. N. L.

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IX.—*Note on the Coal discovered at Khyúk Phyú, in the Arracan District.*

[Read 30th October, 1833.]

Lieut. Foley has been most active in investigating the mineral resources of this almost impenetrable country, where swamps and jungles of the worst description render it hazardous to reside, while they hide for the most part the features by which a geologist is enabled to direct his researches.

The seam of coal discovered at *Syneg Kyong,* as shewn in Captain Margrave's sketch, Plate XIX. Fig. 3. is most conveniently situated for exportation, should it turn out abundant, and of good quality. The *Oong Kyong** creek (reed-nala) falls into *Khyúk Phyú* harbour, just beyond the anchorage of the ships, and the nala itself is deep enough for all small vessels. The following description of the place is extracted from a note by Captain Margrave.

"The hill towards the creek describes the segment of a circle, is very steep, and no more I think than 50 or 60 feet from the sea level; the soil is sand and clay, variously proportioned, of grey, yellow, and sometimes a reddish colour, resting apparently on coarse grey sandstone. It is isolated by the spring-tide, whose fall leaves exposed a flat level ledge of rock, (extending some 70 yards or more N. W. of the hill,) composed of grey sandstone with a brick-red tinge on the surface, particularly near the edges of the blocks and fissures. This sandstone seemed to me to disappear under the hill, for on the other side I found precisely similar stone in fragments, but not the same perfectly horizontal bed. The vein of coal runs about E. and W. (along the line DB) across the southern part of the ledge; at B is the pit sunk by Lieut. Foley, 3 or 4 feet deep, on a former visit: at A and C are the smaller excavations whence came the best specimens of ore and coal. The vein is not straight, however, but rather serpentine, or

* In the plate this has been called *Syneg-kyong* by mistake.—Ed.

zig-zag from D to B, where it disappears, apparently passing under the hill. The seam is nearly vertical, from 80° to 85° dipping to the north. The order of the strata from the north was—1, the reddened grey sandstone; 2, a black or dark-grey sandshale, mixed with thin veins and grains of coal; 3, the hard brittle shining jet coal, sometimes covered with a yellow argillaceous substance, with layers of the sandstone and fibrous bituminous shale; then came the pure coal, succeeded below by the same mixed substance, and this followed by a hard grey sandstone. We followed the vein down as well as our imperfect means would permit, but lost it always I think at the depth of 2 or 3 feet. Including the soft layers it was generally from six inches to a foot in thickness, and could be distinctly traced from D to B by the blackish grey appearance of the stone. My attention was most excited however by the abundance and apparent purity of the iron pyrites, which was extracted during such imperfect operations."

Lieut. Foley subsequently extracted a considerable quantity of the *Syneg Kyong* coal, and of the curious silicified coal found here and elsewhere in contact with it*: some of the latter specimens are almost wholly converted into silex, and give an insight into the process of formation of the fossil wood so common in Arracan, Ava, and Assam. As to the denomination of the *Khyúk Phyú* coal, whether it be what used to be called a true coal or a more modern lignite†, it is of little importance now that all such formations are attributed to a similar origin, namely, the gradual deposition of vegetable matter along with the sedimentary sands, and mud of an ancient river or estuary. It is the extent and thickness of the bed which is of importance, and in this the *Syneg Kyong* coal seems to be deficient as far it has been hitherto explored. This circumstance and the quantity of pyrites may deprive it of a part of its value, although it is otherwise of a very rich and good quality, and well adopted for getting up boiler heat. The analysis of the larger specimens sent through Mr. H. Walter, Commissioner of Arracan, being more accurate than that noted at a former meeting, is here repeated.

| | Syneg Kyong coal. | Oogadong lignite. | Silicified coal with ditto. |
|---|---|---|---|
| Volatile matter.... | 37.1 | 63.0 | 3.2 |
| Carbon.. ....... .... | 60.5 | 35.5 | 4.3 |
| Red ferruginous ash, | 2.4 | 1.5 | 0.0 |
| Silex........ ... | | | 92.5 |
| | 100.0 | 100.0 | 100.0 |

* This appears to be the case in a specimen marked No. 5, *Phúringu* coal, which is of the same nature as the silicified coal which accompanied Mr. Walter's specimens of *Sandowy* lignite, and is stated by him to exist in such abundance there.

† See page 606. of the present number.

Lieut. FOLEY describes the *Oogadong* and silicious or *Phúringú* beds of coal as follows:

2. The *Oogadong* coal (See. Pl. XIX.) occurs in what geologists would call the newest flœtz trap formation: it consists of pitch-coal, brown coal, and a slate coal; it is found in conjunction with iron pyrites beneath a stratum of sandstone, &c. similar to that of *Syneg Kyong.* The vein appears to run from east to west, extending from the foot of a small hill towards the sea.

3. The *Phúringú* bed is apparently a continuation of the last, lying in the same direction, at the distance of two coss, though separated by the sea. It crops out from between layers of a fine greyish sandstone, in a small island, one of the "*Balúngahs,*" or broken islands: the beds are nearly horizontal, dipping slightly towards *Oogadong.*

Lieut. FOLEY also alludes to the plentiful supply of coral lime along the coast, and in Ramree Island, where there is a loose calcareous rock forming low hills in the direction of Moira, probably formed from the degradation of the coral.—There are mud volcanoes in Ramree as in Cheduba*, which spout out abundance of pyrites and kidney iron ore. A crater of this kind is pointed out at *Oogadong,* where scoriaceous matter, trap minerals, and basalt shew evidence of more active volcanic agency in times past. Petrified wood occurs also near Nagadong.

J. P.

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## X.—*Analysis of Books.*

### *Transactions of the Batavian Society of Arts and Sciences, Vol. XIII.*

The half of this volume is occupied by a subject, we may say, of interest to every individual in the world; Cholera Morbus. Important however as it may be in itself, it has now been the subject of so many volumes, treatises, and essays, that each singly conveys but little information that is new, and the greatest part of any one is a repetition of the others. Unfortunately also it cannot be said that all the labours of medical men have advanced our knowledge respecting this formidable disease much beyond what it was in the first year of its appearance. It would be difficult to name a subject in Pathology which medical men have ever so heartily and so strenuously united to investigate, and on which such a mass of intellect throughout every quarter of the world has directed its concentrated energy, and yet after sixteen years of unwearied observation, experiment, and research, we are obliged to confess that the cause of Cholera is unknown, its pathology inscrutable, and its treatment totally unsettled.

These reasons might be supposed sufficient to induce us to pass over very briefly the articles on Cholera in the present publication: as however among all the

* Nodular iron pyrites, the exterior of which has been deprived of its sulphur, and converted into red oxide of iron by heat.

opinions respecting it which have been published, those of the Dutch Physicians in the Eastern Archipelago are perhaps the least known, it may not be uninteresting to give a brief analysis of them as they appear in these Transactions.

I. The first paper is by Dr. M. T. G. MULLER, Physician to the Hospital at Wiltevrede. He sets out with an account of the several appearances of Cholera in the Eastern Islands: the first notice of it is in Bontius, Physician to the Dutch Settlement of Batavia, who published an account of the diseases of the East Indies in 1629, and among others of Cholera Morbus, which according to him was so violent, that "Cornelius Van Rayen, steward of the hospital of the sick, being in perfect health at six in the evening, was suddenly seized with the Cholera, and expired in terrible agony and convulsions, before twelve o'clock at night; the violence and rapidity of the disorder surmounting the force of every remedy." Bontius, Chap. vi.

On the news of the appearance of Cholera in Malacca in 1819, the Dutch Government of Java directed all ships coming from infected parts to undergo a strict quarantine. In spite of this, the disease broke out at Java in April, 1821, with such violence, that at Batavia, 156 deaths took place in one day, and by June it had visited every quarter of the island. The violence abated in December, by which time it is reckoned 110,000 persons fell victims to its rage.

This, it will be seen, is a very different account from that in the Lancet, the Editor of which is determined to maintain the contagious nature of the disease, and shapes according to that the history which he gives in the number for November 1831. He informs us that,

"In 1823, coincident with the Burmese war, and the march of our troops from sick districts in British India, the Birman empire became affected. Coincident again with the general or particular periods of the arrival of individual vessels or trading flotillas, we find the malady in Acheen, the capital of Sumatra; at Banca, Java, and Borneo, in the Philippine Islands; at Amboyna, in the Molluccas, and at length in Macao and Canton on the west coast of China."—

Thus insinuating that it did not appear in Java before 1823, and omitting all mention of the quarantine.

The author then gives a summary account of the course of the disease—"A few minutes after being attacked by Cholera, the following appearances are observable. The patient lies without motion, stretched out in one posture; the skin is blue or dirty brown, and sometimes marked with livid or purple spots, as is seen in frozen persons; some times altogether dry, at others covered with cold sweat. It is cold, hard, and contracted, quite different from health, and conveys to the fingers, particularly when covered with sweat, a peculiar disagreeable sensation. The *turgor vitalis* disappears, so that even corpulent persons appear to have become lean*. The countenance falls in, and indicates great weakness; the forehead is covered with cold sweat; the eyes lie deep in their sockets, and are surrounded with a dark ring. The half shut eyelid allows only a part of the muddy eyeball to be seen, but whenever it is fully opened, the exhausted eye looks out with a melancholy gaze. The blue lips remain half open, and allow exit to cold expiration; the chest heaves laboriously, the abdomen labours to maintain the respiration. It is however tolerably even, and neither tumid nor retracted; the extremities are stiff, the skin of the half shut hands wrinkled as in persons who work much in water, but cold,

* This striking symptom appears to be unnoticed in our Medical Publications.

and the nails are blue. The patient appears almost quite indifferent to his situation, and speaks unwillingly.

"Scarcely have these appearances been observed than the scene changes. The half dead patient revives, the countenance assumes a painful expression, the legs are drawn to the belly, the feet and toes crook themselves downwards, hard moveable knobs are felt in the calves and thighs. These are the muscles drawn together by agonizing cramps. The arms are also often attacked by cramps, and the patient exhibits such strength that several persons are necessary to hold him. Oppressive sighing takes place ; the cramps at length cease, but another painful phenomenon makes its appearance ; the patient worn out by internal heat, cries out for cold water, swallows a quantity of it greedily, which scarcely gets to the stomach before it comes up again, generally followed by severe retchings ; and in proportion as the stomach empties itself above, so the bowels empty themselves below in rapid succession of evacuations of a large quantity of thin rice-water liquid, which generally exhaust the patient, who now refuses to speak, except to cry for drink, or utter broken complaint of weakness, and groanings extorted by the spasms." Page 7.

The author then proceeds to a more minute and detailed account of the whole course of the disease, which he divides into three stages. The first, consisting of the preliminary symptoms till the appearance of vomiting ; the second, from that period till the commencement of the state of torpor and insensibility ; the third, from thence to death. In all this it will be seen that not the least notice is taken of the state of re-action previous to death on which the European Physicians dwell at such length ; nor indeed has it been noticed by any practitioner we believe in this country. Is this state peculiar to the Cholera of cold climates, and does it constitute a difference between the disease as it occurs there and in India ?

The reader must always remember that there is a certain degree of Poetry in Physic as in every thing else, and that a sick man constitutes in some respects a very picturesque object, particularly when dying of a horrible and incurable disease. Most Physicians (even the very soberest) are apt to indulge their poetical vein a little in describing the circumstances of such patients, and to make a striking picture out of the collection of their symptoms. Hence in reading accounts of Cholera, or indeed of any other fatal ailment, we must always substract a certain proportion of the terrible, and endeavour to judge of what the description would be, if written in plain prose.

Dr. Muller then goes on to an account of the *post-mortem* appearances, which are detailed with great minuteness ; he divides them into sections, the external appearances, the cranium, the thorax, the heart, the lungs, the abdomen, the stomach, the duodenum and jejunum, the ileum, the mesentery, the colon, the liver, the gall-bladder, the spleen, the kidneys, the bladder, the abdominal ganglia: of these last the aathor observes, that "they have been frequently examined without exhibiting any thing unusual except an increase of redness, arising from the plethora of their blood vessels, the ganglions themselves seemed unaltered." P. 39.

He then proceeds to the diagnosis, which we pass over, concluding that it can present little difficulty. The symptoms of Cholera are too formidable to be easily or frequently mistaken.

Then follow the causes of Cholera, in which however he merely confines himself to that disposition of body which renders an individual susceptible of the disease, and this in general he considers to be debility, or, to use his own words, "It thus appears, that a weakened state of the body produces the chief predisposition to Cholera. By a weakened body, I understand a body in which the vital powers have descended below their just and necessary degree : a weak body is quite a different thing, that is, only in comparison with other stronger bodies ; a smaller degree of vital power, which may however be just and complete for the health of that individual itself." P. 54*.

He observes with respect to Europeans, that the disease does not appear in them on their first arrival in Java, but generally after they have been some time resident, and the climate has begun to affect them. He then reviews the various opinions respecting the exciting cause of the disease, and is dissatisfied with them all. He himself offers nothing better than an altered state of the atmosphere.

After an investigation of the proximate cause the author sums up thus, "A sudden and great debility of the nervous and vital powers, with increased excitement in the abdominal viscera, are the proximate causes of Cholera." P. 64.

We fear this explanation casts but little light on the disease. He then goes on to the prognosis, through all the minutiæ of which, we cannot follow him ; he seems to lay most stress on the state of the pulse.

"The first and chief symptom on which any hope of recovery can be founded is the pulse becoming stronger ; it is of little consequence whether it be quicker or slower, harder or softer, if at the same time it exhibits more fulness ; nay a slight variation in the pulse is not upon the whole a bad sign, as it is generally accompanied by a diminution of uneasiness." P. 71.

We now come to what is most interesting of all, the treatment; and this the author comprizes in four indications : first, the re-excitement and preservation of the nervous and vital powers; second, the restoration of the circulation and the natural state of the blood; third, the diminution of the excitement in the stomach and bowels ; fourth, the diminution of the disposition to spasm.

The means for all this the author divides into two classes, external and internal. In the first class he arranges (whether properly or not), the evacuation of blood by the lancet orleeches ; of the first he observes that it is chiefly useful to full-blooded, fresh-arrived Europeans, not yet become weak. Of the few patients cured under such circumstances, the greatest number have been bled. Leeches produce the same effects, but more slowly; in advanced states of the disease, they remain for hours on the patient's skin without becoming fuller. He then discusses the derivantia, that is, all those means which, by exciting the skin, diminish the internal irritation. He lays a good deal of stress on simple shampooing, and then on dry friction ; he approves of the application of mustard paste† to the breast and extremities : moxa can hardly be used ; but in two instances, the author made a moxa of phosphorus, and burnt it on the spine, without any effect.

He then enters upon the external medicines ; the well known list of stimulants, alcohol, ether, oleum menth. &c : even phosphorus, he says, was tried to the extent of four grains in 24 hours, to no purpose : opium he declares to have had no visible

* It is a little odd that this should be the doctrine of the old Arabic Physicians, in what they called Aslah-ool Amzijati lahoo, by which they meant, not the best state of health absolutely, but the best state of health with reference to the constitution of a given individual. See printed Edition of the Kanooncheh, 1827. P. 3.

† This remedy is also highly, and we believe justly extolled by Dr. Twining. Practical Account of Epidemic Cholera, 1833. P. 72.

effect on the disease: of calomel, he observes, that it was much more used formerly than now, and he ends with a list of the cholera mixtures published officially in the Batavia Courant. We select one or two of those least used with us.

(4) *R.* Infus, Valerian, .... ℥v.
Ol. Cajapooti, ...... ℈i—ii.
Æther Sulph. acet..... ʒii
A spoonful every hour.

(5) *R.* Calomel,.............. ℈i
Camphor. elect.. .. gr. viii
Opii pur. ............ gr. iv
Sacch. Alb. ... ...... ʒi
divide in pulv. vi.
One to be taken every quarter of an hour.

(6) *R.* Ol. Phosphor, .... ʒs. ( ℥i
continet Phosphor .. gr. ii)
Pulv. Gum Arab. ...... ʒi
Aq. Menth............. ℥v
Vini Opii............... ʒi
M. f. emulsio
as the former.

(7) *R.* Aq. Menth........... ℥iv
Acet Morphii... ..... .. gr. iv
M. as the former.

(8) *R.* Ol. Jatrophe,........... ʒi
Pulv. Gum Arab........ ʒi
Aq. Menth.. ......... ℥iii
M. every hour two spoonsful.

II. The length of our observations on this first article renders a detailed account of the succeeding on the same subject unnecessary, by H. Schillet, Surgeon Major of the Royal Netherland Marine. He inquires into the name of the disease, its cause, (in which he is an opponent of contagion) its effects, its species, its diagnosis, its treatment, (and here he quotes largely from the works of our Indian Surgeons, Johnson, Corbyn, Boyle, Tytler, &c.) and then the post-mortem appearances. In these he chiefly notices the state of the brain, and gives a plate of that organ, its vessels loaded with blood, and the dura mater deeply stained with inflammation. He also gives a figure of a portion of the stomach and the jejunum. In an account of the prophylactics, he takes notice of the dispute respecting the effects of bad rice in exciting the disease. "It is well known, that Dr. Tytler connected the food of the Hindoos with this disease, and on account of the bad qualities of the last rice crop, which is their daily food, he ascribed this epidemic sickness to that; thereupon his well-known work saw the light, endeavouring to ascribe the epidemic which has prevailed in different parts of the world, for many years, to the bad qualities of the rice, on which account he gives to the Indian cholera the name of morbus oryzeus; bad food is doubtless one of the chief predisposing causes of this disease, but certainly not the proximate cause." P. 178.

III. The next article is *a dissertation on the origin of the Japanese, by* Dr. Vonsiebold. Like all other eastern nations, these people pretend to a divine origin and unfathomable antiquity. The race of gods, called Tewsen Setsidai, had employed themselves, somewhat unsatisfactorily we should think, for millions of years in hovering over the land of Nippon: at length the seventh in succession to the celestial throne, by name Tsanage Namik, with his wife, came to the resolution of descending from the clouds on Japan, and there multiplying like men, they produced a race of demigods of limited but very long life, and dignified with polysyllabic names.

European antiquarians have given various interpretations of this fable, with which we need not trouble our readers. Four different opinions are entertained respecting the origin of the Japanese:—

A. That they are descendants of the Chinese.

B. Or of some of the Tartar tribes.

C. Or of a mixture of various Asiatic tribes.

D. Or they are aborigines.

Which last supposition cuts the knot at once.

The resemblance between the Chinese and Japanese is so strong, in physiognomy, religion, and manners, as as to have impressed all travellers with the idea of the latter people being a colony of the former.

The author omits other considerations, and enters into an inquiry respecting the oblique position of the eyes, supposed to be peculiar to the Chinese, and the nations consanguineous with them; but as he observes, nothing can be built on this till it be ascertained what are the Asiatic tribes to whom this conformation belongs, and whether any of those of North and South America partake in it. The skin of the Japanese is of all colours; in town many approach to the fairness of Europeans, in the country they are copper red or earthy cloured.

His next inquiry is into the resemblance of the Japanese and Chinese language and writing. The Chinese say, the first appearance of the Japanese among them was A. D. 57, at which time, they were barbarians, without writing, government or morals, but they at the same time assert, that Japan was peopled by a colony of Chinese in the year 1195 before Christ; if so, why did not this colony carry their writing and manners along with them? The author allows that Japanese writing is borrowed from the Chinese, but still contends, that Japan must have been peopled by a nation using a different language from theirs.

The Japanese alphabet consists of 47 letters, which are originally Chinese characters, having the same sound; but the Japanese language, unlike that of the Chinese, is polysyllabic: hence, says the author, Japan must have been peopled by some Asiatic tribe before the art of writing was spread through the northern parts of Asia.

The author next proceeds to the religion, and, "Though," says he, "I cannot prove that the religion of the old inhabitants of Japan might not have been the same with that of their Chinese contemporaries, yet I can maintain, that the religion prevailing among the Chinese and Japanese in the present day has not the least resemblance to that of the ancient Japanese." P. 220. To prove this, the author enters into a long investigation of the ancient and modern Chinese and Japanese godderies, which we have found it difficult to understand, and would find it more so to make intelligible to our readers; we shall therefore take it for granted that he has proved his point, and go on to the rest of the argument.

The author then considers the relationship between the Japanese and the Tartar races, but we have not leisure to follow him through this research, particularly, as after examining the language and manners of the Japanese and the neighbouring kingdom of Corea, at great length he does not appear to come to a positive conclusion. He then asks if the Japanese are a mixed race, composed from various Asiatic clans; and though the author is not very clear, we consider this the opinion to which, upon the whole, he is most inclined. He even considers that there is a strong relation between these tribes and the Peruvians, and gives some instances of verbal resemblances in their respective language, thus supporting the theory of Mr. RANKEN on the origin of the Peruvians. He concludes, "I commit these fragments to the hands of the literati, earnestly entreating them to receive with favour the nosegay I have gathered with so much care from the islands of this archipelago and the neighbouring continents, and to take them under their *high and mighty protection.*" P. 275.

IV. The next paper by M. H. HALEWYN is *an account of the tribe called the Dayakkers of Borneo.* They seem in a very low state of civilization, being totally ignorant of reading and writing, and have a number of very peculiar customs well worth noticing, did our space allow of it. We shall only notice one, which will serve as a complete refutation of those who are disposed to hold Oriental civilization in low estimation. "The Dayakkers are governed by their chiefs, who are entirely dependent on their subjects, and are chosen from the eldest of the people. If the chief acts arbitrarily, the people rebel against him and put another in his place." P. 291. This it must be confessed is the very acme and beau ideal of government, sufficient surely to satisfy the most liberal reformer. How wonderful it is that so perfect a scheme should, in the midst of the march of European intellect, be reserved for such a remote and unnoticed part of the world as this. "There are," proceeds the author, "many debtors in *Dayak:* the custom is, that if the debt be not discharged in four months, it is doubled." P. 291. This is worse than Calcutta Sircars and Life Insurances yet.

V. The next article by Mr. VANDER JAHT is *an account of the groupe of islands called the Kokos or Keeling Islands*, of which a full and authentic account, derived from the Reports of Admiral OWEN to the Government, was published in the GLEANINGS OF SCIENCE, for Oct 1830. The article terminates with an account of the interview between the author and Mr. ROSS, also given in the GLEANINGS.

VI. The last article is an *account of the mountains of Tinger, in Java, by* H. T. DORNIS, Resident at *Soorabay.* The author examines their geographical situation, the dwellings of the inhabitants, their religions, their mode of prayer, their festivals, their ceremonies of birth, marriage, and funerals; all these seem borrowed from the Indian Brahmins, and are quite different from the Muhammedan Javanese. Above the head of BRAHMA, VISHNU, and SIVA, however, they acknowledge a supreme power, whom they call PRABO GORO INGLOHOR. One or two singular customs may be noticed—"widows are highly prized among them, and as soon as a woman has lost her husband she is sought after by almost all the bachelors; a young miss gets a husband with great difficulty." P. 330.' One might be tempted to ask how then are widows produced? The case is similar to WINIFRED JENKIN's puzzle as to how sheep's heads could be found in Scotland unless there were sheep too. "When the Tingerians wish to exhilarate themselves, they drink tocak, i. e. fermented palm wine, mixed with water, which renders them immensely frolicksome; the smoking of opium and drinking of strong waters is unknown." Ibid. We know not whether the Temperance Societies would approve this distinction.

On the whole, the author is so delighted with the climate and manners of the Tingerians, that he breaks out into a Virgilian rapture, which not to do him injustice, we shall give both in the original and translation as a conclusion to our analysis. "Gelkkige bewoners van Tinger! hoe weining gevoelt gij mischien zelve het vo oregt hetwelk gij geniet!"

"Happy inhabitants of Tinger, how little perhaps do they feel the privileges which they enjoy."

## XI.—*Miscellaneous.*

### 1.—*Register of the Temperature of Ghazipur. By the Rev.* R. Everest.

I am fully aware how imperfect these observations are, but in this country, where so little has been done, I publish them in the hope they may hereafter be of use to individuals engaged in the same pursuit. To obtain the mean of every hour in the 24, as was done at Leith, is beyond the power of any one without assistance.—R.E.

| | | in 1831-2 | | | | in 1832-3. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Sun-rise. | ½ past 2 P. M. | Mean. | Mean range. | Sun-rise. | ½ past 2 P. M. | Mean. | Mean range. |
| 1831. | | | | | | | | | |
| April, .... | Highest, .. | 86 | 111,1 | | | 78 | 110,6 | | |
| | Lowest, .. | 70 | 93,5 | | | 62,5 | 85 | | |
| | Mean, .... | 76,9 | 99,2 | 88,05 | 22,3 | 72 | 98,4 | 85,2 | 26,4 |
| May, .. .. | Highest, .. | 90 | 111,6 | | | 81 | 112,5 | | |
| | Lowest, .. | 81 | 95 | | | 69 | 97 | | |
| | Mean, .... | 86 | 109,5 | 97,75 | 23,5 | 76,2 | 107,6 | 91,5 | 31,4 |
| June, .... | Highest, .. | 87,5 | 111,2 | | | 84 | 115,5 | | |
| | Lowest, .. | 77 | 79 | | | 75 | 81 | | |
| | Mean, .... | 82 | 97,6 | 89,8 | 15,6 | 80,6 | 102,2 | 91,7 | 21,6 |
| July, .. .. | Highest, .. | 82,5 | 103,5 | | | 83,5 | 106,5 | | |
| | Lowest, .. | 75 | 85,5 | | | 75 | 82 | | |
| | Mean, .... | 80,6 | 94,1 | 87,35 | 13,5 | 80,7 | 94,8 | 87,75 | 14,1 |
| August, .. | Highest, .. | 81,5 | 96 | | | 83 | 100,5 | | |
| | Lowest, .. | 77,5 | 79,7 | | | 77 | 81 | | |
| | Mean, .... | 79,7 | 89,1 | 84,6 | 9,4 | 79,2 | 91,1 | 85,15 | 11,9 |
| September, | Highest, .. | 82,5 | 98 | | | 80,5 | 99 | | |
| | Lowest, .. | 73 | 80,5 | | | 72 | 82,5 | | |
| | Mean, .... | 78,3 | 90,1 | 84,2 | 11,8 | 76,9 | 91,7 | 84,3 | 14,8 |
| October, .. | Highest, .. | 78 | 94 | | | 76 | 94 | | |
| | Lowest, .. | 59,5 | 85,5 | | | 63 | 73,5 | | |
| | Mean, .... | 70,5 | 89,9 | 80,1 | 19,4 | 70 | 78,5 | 79,2 | 18,5 |
| November, | Highest, .. | 72,5 | 88,5 | | | 65 | 90 | | |
| | Lowest, .. | 46,5 | 74 | | | 51 | 80,5 | | |
| | Mean, .... | 53,2 | 79,1 | 66,25 | 25,9 | 56,7 | 84,4 | 70,5 | 27,7 |
| December, | Highest, .. | 65 | 70,5 | | | 63 | 88 | | |
| | Lowest, .. | 46 | 63 | | | 38 | 66,5 | | |
| | Mean, .... | 55,4 | 67,9 | 61,65 | 12,5 | 50,3 | 74,5 | 62,4 | 24,2 |
| 1832. | | | | | | | | | |
| January, .. | Highest, .. | 53 | 77,5 | | | 57 | 83 | | |
| | Lowest, .. | 39 | 62,5 | | | 37,5 | 68 | | |
| | Mean, .... | 45,3 | 68,4 | 56,85 | 23,1 | 47,1 | 75,5 | 61,3 | 28,4 |
| February, .. | Highest, .. | 60 | 76 | | | | | | |
| | Lowest, .. | 41 | 70,5 | | | | | | |
| | Mean, .... | 50,7 | 73 | 61,85 | 22,3 | | | | |
| March, ... | Highest, .. | 66 | 94 | | | | | | |
| | Lowest, .. | 47,5 | 77 | | | | | | |
| | Mean, .... | 55,5 | 84,2 | 69,8 | 28,7 | | | | |
| Yearly means, .... .... | | .... | ...... | 77,36 | 19,0 | | | | |

*Radiation.*—I also made a few experiments on Radiation towards the latter end of the year 1832. The Thermometer was covered with black wool, and laid on the grass. The following are the results :

| Sept. | | | | | A. M. | | | | | | | | | | | | P. M. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 28 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 137.5 | .. | 144.5 | 140 | .. | 126 | 103 | .. | 81 | | | | | | 73 |
| 29 | 72.5 | .. | 70 | 70 | 68.5 | 69.5 | 80 | 94.5 | 108 | 131 | 140 | 140 | 138 | 132 | 122 | 106 | 93 | 82 | 77.5 | 76 | 74 | 72.5 | | |
| 30 | .. | .. | .. | .. | 70.5 | 71 | .. | .. | 106 | 129 | 138 | 140 | 135.5 | 129 | 119 | .. | | 82 | 78 | | 76 | 76 | 75 | 74 |
| Oct. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | .. | .. | .. | .. | 71 | 70.5 | .. | .. | .. | .. | .. | 140 | .. | .. | 119 | .. | | | | | 79 | | | |
| 2 | .. | .. | .. | .. | 74 | .. | .. | .. | .. | .. | 142 | 141 | | | | | | | | | | | | |
| 3 | .. | .. | .. | .. | 75 | .. | .. | .. | .. | .. | .. | 142 | .. | .. | .. | .. | | | | | | 79 | | |
| 4 | .. | .. | .. | .. | .. | . | .. | .. | .. | .. | 142 | .. | .. | .. | .. | .. | 76 | | | | | | | 71.5 |
| 5 | .. | .. | .. | .. | 73 | .. | .. | .. | .. | .. | .. | .. | .. | 120 | .. | .. | | | | | 76 | | | |
| 6 | .. | .. | .. | .. | 73 | .. | .. | .. | .. | .. | .. | .. | .. | 128 | .. | .. | | | | | 75 | | | |
| 7 | .. | .. | .. | .. | 75 | .. | .. | .. | .. | .. | .. | 129 | .. | 101 | .. | .. | | | | | 72 | | | |
| 8 | .. | .. | .. | .. | 71.5 | : | .. | .. | .. | .. | 72 | | | | | | | | | | | | | |
| 9 | .. | .. | .. | 67.5 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | | | | | | | | |
| 10 | .. | .. | .. | .. | 62.5 | .. | .. | .. | .. | .. | .. | .. | .. | 128 | .. | .. | | | | | | | 64 | |
| 11 | .. | .. | .. | .. | 60 | 59.5 | .. | .. | .. | .. | .. | 132 | .. | .. | .. | .. | | | | | 62 | | | |
| 12 | .. | .. | .. | .. | 57 | .. | .. | .. | .. | .. | .. | 138 | .. | .. | .. | .. | | | | | | 64 | | |
| 13 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 137 | .. | .. | .. | .. | | | | | 68 | | | |
| 28 | .. | .. | .. | .. | 59 | .. | .. | .. | .. | .. | .. | 124 | .. | 102 | .. | .. | | | | | 65 | | | |
| 81 | .. | .. | .. | .. | 60 | .. | .. | .. | .. | .. | 132 | 130 | .. | 124 | .. | .. | | | | | 66 | | | |

I subjoin, for the sake of comparison, the height of a Thermometer suspended in the shade, during the above days.

| 1832 | | | | | A. M. | | | | | | | | | | | | P. M. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sep. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 28 | .. | .. | .. | .. | .. | 72 | .. | .. | .. | .. | .. | .. | 90 | .. | 86,5 | .. | | 83 | | 80 | | | | |
| 29 | 76.5 | .. | 76.3 | 75.5 | 74.8 | 75.5 | 78.3 | 80.5 | 83.5 | 86.6 | 89.2 | 92.1 | 93.5 | 88.5 | 87.7 | 86.1 | 85.5 | 83 | 81 | | 79 | 78 | | |
| 30 | .. | .. | .. | .. | 75.5 | 75.3 | .. | .. | .. | 86.8 | 90 | 92.3 | 95.5 | .. | 90 | .. | | 83 | 81 | | 79 | 79 | 78.4 | 78 |
| Oct. | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | .. | .. | .. | .. | 76 | 76 | .. | .. | .. | .. | .. | .. | .. | 94 | .. | .. | | | | | 80 | | | |
| 2 | .. | .. | .. | .. | 77.5 | .. | .. | .. | .. | .. | .. | 94.5 | .. | .. | .. | .. | | | | | 82.5 | | | |
| 3 | .. | .. | .. | .. | 77.5 | .. | .. | .. | .. | .. | .. | 96.8 | | | | | | | | | | 82.5 | | |
| 4 | .. | .. | .. | .. | 78 | .. | .. | .. | .. | .. | .. | .. | .. | 88.5 | . | .. | 76 | | | | | | | 73 |
| 5 | .. | .. | .. | .. | 74 | .. | .. | .. | .. | .. | .. | .. | .. | 88.5 | .. | .. | | | | | 76 | | | |
| 6 | .. | .. | .. | .. | 74.2 | .. | .. | .. | .. | .. | .. | .. | .. | 90.5 | .. | .. | | | | | 76 | | | |
| 7 | .. | .. | .. | .. | 75 | .. | .. | .. | .. | .. | .. | 87 | .. | 84 | .. | .. | | | | | 74 | | | 72.5 |
| 8 | .. | .. | .. | .. | 71.5 | .. | .. | . | .. | .. | .. | .. | .. | 90 | .. | .. | | | | | | | 77.5 | |
| 9 | .. | .. | .. | .. | 71.5 | .. | .. | .. | .. | .. | .. | .. | .. | 93 | .. | .. | | | | | | | | |
| 10 | .. | .. | .. | .. | 68.5 | .. | .. | .. | .. | .. | .. | .. | .. | 93.5 | .. | .. | | | | | 79.5 | | 75.2 | |
| 11 | .. | .. | .. | .. | 66 | .. | .. | .. | .. | .. | .. | .. | .. | 92 | .. | .. | | | | | | | | |
| 12 | .. | .. | .. | .. | 63 | .. | .. | .. | .. | .. | .. | .. | .. | 92 | .. | .. | | | | | 60.5 | | | |
| 13 | .. | .. | .. | .. | 68.5 | .. | .. | .. | .. | .. | .. | .. | .. | 93 | .. | .. | | | | | | | | |

## 2.—*Note on the Salájít of Nipal.*

*To the Editor of the Journal of the Asiatic Society.*

Dear Sir,—I have been much gratified and interested by reading Mr. Campbell's paper on the native alum, or *Salájit* of Nipal. I think it is more than probable, that if an average sample of the various qualities were collected, and subjected to analysis, the general result would be what Mr. C. has advanced, viz. about 66 per cent. of sulphate of alumina. As I had only one quality to operate upon when I made my analysis, why it was " Hobson's choice" with me. From the information I could gather from Nipal merchants, I am led to believe, that Mr. C. is perfectly correct as to the quantity that may be collected.

But what I am now going to state, may set the matter beyond a doubt. I have seen the organic remains of an ammonite (*Ammonites sacer* of Sowerby) imbedded in alum shale from the banks of the *Gandak* river in its early course. This perfectly agrees with specimens (now in my possession) which I formerly collected at the alum works on the Yorkshire Coast to the north of Whitby. This fact I think clearly proves the existence of alum shale strata in the secondary formations at the foot of the Himálya range, and that it may extend through the hills of Nipal. I also concur with Mr. C. relative to the tedious and expensive processes attending the manufacture of alum at home; so much so, that the return has scarcely equalled the outlay. A friend of mine knows this to his cost.

I have no doubt but European skill and capital will shortly turn to some account these notices of a native, and valuable substance, which has not remained hidden, but has been at least unknown to the generality of enterprizing commercial men.

In conclusion, should this meet the eye of Mr. CAMPBELL, I beg leave to thank that gentleman for his kind offer of assistance, and will feel obliged by his sending me samples, or specimens of the various kinds of *Salájit*, especially the black kind, a variety which I have not yet seen. Any expense in collecting, or conveyance to my address, (Singhea, Tirhoot,) will be cheerfully paid.

I am, dear Sir, &c.

10*th Nov.* 1833. J. STEVENSON.

### 3.—*Summary Sketch of the Geology of India.*

[Extracted from the Rev. W. D. Conybeare's Report to the British Association at Oxford,1882.]

In Southern Asia, many of the British residents have been far from inactive; among these we may specify the names of FRANKLIN, VOYSEY, HERBERT, CHRISTIE, LOW, HARDIE, and GOVAN: but CALDER'S General Memoir on the Geology of India conveniently and ably brings together in one view the substance of the insulated observations of others.

From these sources we learn, that primitive formations, in which granitic rocks bear the principal proportion, occupy not only the great Himálayan northern chain, but also three-fourths of the entire peninsula, from the vale of the Ganges below Patna to Cape Comorin; although these rocks are frequently overlaid by a thin crust of laterite (a ferruginous clay, considered as associated with the trap formation). The transition formations have not been clearly distinguished; the secondary formations described are:—1. The carboniferous group. Coal has been said to occur extensively in the grits bounding the southern slope of the Himálaya; but it has been questioned, whether this formation is the older coal, or only lignite associated with nagelflue, (as on the slope of the Alps;) it has been particularly described however where the river Tista issues from this chain (88° 35′ Long. E.), and there undoubtedly bears all the characters of the older formation; its strata are highly inclined, whereas the tertiary beds, and even most of the secondary in this part of India, are horizontal: but the only coal district regularly worked is that on the river Damúda, about 100 miles N. W. of Calcutta; this extends on the banks of that river about 60 miles, and appears from its fossil *lycopodia* to be undoubtedly the older coal; it reposes apparently on the surrounding primitive rocks, but it has been conjectured, that it may possibly extend across the delta of the Ganges to Silhet (almost 306 miles distant at the eastern extremity of Bengal); it seems doubtful however whether the Silhet coal be not really modern lignite, as tertiary rocks certainly prevail in that quarter. No carboniferous limestone has been observed.

2. Next to the coal we have to notice a great sandstone formation, which is usually considered equivalent to our new red sandstone; this includes many variations of character, comprising, besides sandstone and conglomerates, shales often approximating to older slate; the diamond mines of Panna (in Bundelkhand) and of the Golconda district are situated in this formation, the matrix being a conglomerate bed with quartzose pebbles: rock salt and gypsum are found where this formation extends on the N. W. into the great basin of the Indus: the stratification is uniformly horizontal: no organic remains occur. Beginning at the Ganges

on the east, this formation first shows itself, supporting basalt, on the Rajmahal hills; it again prevails throughout the interval between the confluences of the river Sôn (Soane) and of the Jamna with the Ganges, and thence stretches across W. S. W. through the Bundelkhand district to the banks of the Nermada (Nerbudda), which flows into the Gulf of Cambay, as far as 79° Long. E.; where it is overlaid by the eastern extremity of the great basaltic district of North-western India near Ságar: the red sandstone shews itself again emerging from beneath the north-western edge of this basaltic district, at Nímach, near the western sources of the Chambal (the great southern branch of the Jamna) and at Baug, in the valley of the Nermada. In both places, as also along the central portion of the platform before described, stretching through Málwa, it is frequently covered with a thin crust of grey argillaceous limestone, supposed to represent our lias, but nearly destitute of organic remains, although a single gryphite is said to have been found. The general absence of organic remains in the secondary rocks of India is remarkable; but Mr. Voysey mentions an argillaceous bed full of fossil shells (species not stated) beneath the trap of the Gáwilgarh hills (between the confluences of the Tapti and Purna, in the Berar district:) the same lias-like beds occur with the red sandstone of the Golconda district. A primitive range, extending from near Delhi to the head of the Gulf of Cambay, separates the secondary rocks of Málwa from those of the great basin of the Indus; but on the western borders of this ridge through Ajmír, the red sandstone again shews itself, containing rock-salt and gypsum. The whole of this immense basin appears to have been hitherto geologically neglected, although it would probably best repay such an examination, for here if any where in India, we might most probably expect a fuller series of secondary rocks. Mr. Govan has observed at the very source of the Satlej, one of the chief tributaries of the Indus, amid the highest primitive peaks of Himálaya, a small basin of secondary limestone, containing ammonites and cardia.

3. Tertiary rocks at the foot of the first rise of the primitive rocks of the Himálaya, in the north west of Bengal, where the Brahmaputra issues from them at the pass of the Garrow hills; *cerithiæ*, *turritelli*, remains of lobsters, sharks, crocodiles, &c. are here found, and further east, *nummulite* limestone prevails at Silhet. The soil throughout Bengal is often occupied by deposits of clay, containing concretionary lumps of limestone, called *kankar;* this, which affords the principal supply of lime in India, is probably of very recent origin. It remains only to notice the great basaltic district of the north-west. This extends from Nagpur, in the very centre of India, to the western coasts between Goa and Bombay, occupies the whole of that coast to its termination at the Gulf of Cambay, and thence penetrates northwards as far as the 24th parallel of north latitude.

In the Burmese Empire we find primitive rocks in the chains above Ava, but tertiary beds, with the characteristic shells, in the valley of the Irrawady, near Prome; also remains of the mastodon, &c. in the diluvial gravel. West of this the whole chain of the Malayan peninsula is primitive, consisting principally of stanniferous granite.

I believe that the above, condensed as it is, willbe found the fullest general account of the progress as yetmade in Indian geology, hitherto presented to the public.

*Meteorological Register, kept at the Assay Office, Calcutta, for the month of November, 1833.*

| Day of the month. | Barometer reduced to 32° Farh. | | | | Thermometer in the Air. | | | | | Depression of moist-bulb Thermometer. | | | | Hair Hygrometer. | | Rain. | Wind. | | | Weather. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Minimum at 4½ A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | At 10 A. M. | At 4 P. M. | Inches. | Morning. | Noon. | Evening. | Morning. | Noon. | Evening. |
| 1 | ,875 | ,022 | ,910 | ,975 | 71,2 | 79,9 | 89,8 | 84,0 | 74,3 | 4,1 | 8,9 | 12,5 | 7,0 | 86 | 76 | | o. n. | N. | n. | clear. | clear. | clear. |
| 2 | ,939 | ,990 | ,900 | ,958 | 72,5 | 80,1 | 90,0 | 83,8 | 75,0 | 6,2 | 8,0 | 12,3 | 8,7 | 87 | 75 | | o. n. | n. | o. | do | do | do |
| 3 | ,918 | ,976 | ,878 | ,923 | 74,4 | 81,3 | 93,1 | 83,2 | 75,6 | 4,7 | 7,7 | 10,0 | 6,6 | 85 | 82 | | n. | n. | o. | do | do | do |
| 4 | ,886 | ,961 | ,858 | ,922 | 72,0 | 80,9 | 94,8 | 84,4 | 78,1 | 5,0 | 7,6 | 10,5 | 7,6 | 86 | 81 | | e. | n. | w. | do | do | cumuli. |
| 5 | ,902 | ,010 | ,919 | ,980 | 73,1 | 81,3 | 88,5 | 83,8 | 78,6 | 1,6 | 6,0 | 9,4 | 5,4 | 91 | 83 | | o. | n. | o. | do | cumuli. | inst. abund. |
| 6 | ,976 | ,022 | ,903 | ,953 | 74,5 | 80,0 | 89,0 | 83,4 | 77,8 | 2,5 | 6,0 | 8,8 | 4,7 | 91 | 84 | | o. | n. w. | o. | cirri. | overcast. | haze. |
| 7 | ,912 | ,961 | ,862 | ,929 | 78,5 | 80,0 | 90,4 | 83,6 | 77,2 | 8,7 | 6,7 | 9,2 | 7,7 | 90 | 82 | | o. | n. w. | n w. | stratus. | cumuli. | clear. |
| 8 | ,918 | ,011 | ,921 | ,999 | 73,1 | 81,1 | 94,0 | 83,7 | 75,0 | 3,1 | 7,5 | 10,7 | 6,0 | 88 | 80 | | o. | n. w. | n. | haze. | light clds. | do |
| 9 | ,994 | ,061 | ,953 | ,007 | 71,8 | 80,4 | 95,0 | 83,3 | 76,8 | 4,0 | 7,4 | 11,7 | 9,3 | 87 | 80 | | n. e. | n. e. | o. | clear. | do | do |
| 10 | ,987 | ,064 | ,001 | ,051 | 71,4 | 81,2 | 87,2 | 82,5 | 75,4 | 4,4 | 8,0 | 8,3 | 4,2 | 85 | 85 | | N. E. | n. | o. | haze. | overcast. | haze. |
| 11 | ,002 | ,052 | ,005 | ,054 | 75,1 | 80,5 | 90,8 | 80,0 | 73,0 | 5,4 | 7,5 | 7,5 | 5,8 | 89 | 88 | | o. | w. n. | o. | stratus. | cumuli. | bright. |
| 12 | ,033 | ,100 | ,979 | ,015 | 68,0 | 78,1 | 92,0 | 81,6 | 76,0 | 3,6 | 7,0 | 10,1 | 7,5 | 87 | 82 | | o. | n. w. | n. | clear. | clear. | clear. |
| 13 | ,988 | ,032 | ,940 | ,986 | 70,4 | 79,7 | 89,6 | 82,0 | 75,0 | 3,4 | 8,5 | 11,7 | 8,6 | 84 | 78 | | o. | n. w. | o. | do | do | do |
| 14 | ,903 | ,000 | ,886 | ,913 | 71,0 | 79,0 | 89,8 | 82,1 | 76,8 | 5,3 | 6,6 | 10,7 | 8,1 | 88 | 81 | | o. | n. | o. | do | do | do |
| 15 | ,897 | ,964 | ,863 | ,925 | 72,0 | 78,9 | 90,0 | 81,4 | 74,3 | 5,2 | 6,5 | 9,2 | 6,3 | 88 | 84 | | o. | n. | o. | do | do | do |
| 16 | ,918 | ,009 | ,901 | ,956 | 71,3 | 78,6 | 90,0 | 81,4 | 77,0 | 4,3 | 6,4 | 9,0 | 7,0 | 89 | 84 | | o. n. | w. | o. | do | do | do |
| 17 | ,929 | ,021 | ,892 | ,940 | 73,0 | 79,0 | 91,0 | 80,4 | 78,5 | 3,3 | 6,0 | 7,0 | 7,1 | 90 | 88 | | o. | o. | o. | do | cumuli. | do |
| 18 | ,925 | ,026 | ,905 | ,982 | 74,2 | 78,4 | 89,0 | 82,5 | 74,5 | 3,6 | 6,4 | 11,5 | 7,5 | 90 | 79 | | o. n. | n. | e. | do | do | do |
| 19 | ,978 | ,052 | ,959 | ,993 | 70,1 | 79,0 | 88,0 | 81,7 | 71,2 | 4,1 | 9,5 | 11,2 | 5,8 | 82 | 79 | | o. e. | n. | n. e. | do | clear. | do |
| 20 | ,002 | ,068 | ,946 | ,984 | 70,0 | 77,2 | 87,0 | 81,3 | 76,7 | 4,0 | 6,8 | 10,3 | 6,7 | 88 | 82 | | o. | n. w. | n. | do | do | do |
| 21 | ,968 | ,975 | ,898 | ,923 | 70,0 | 80,0 | 90,0 | 81,5 | 73,4 | 3,5 | 7,8 | 10,0 | 3,8 | 86 | 82 | | o. | n. w. | S. | do | do | do |
| 22 | ,918 | ,980 | ,871 | ,947 | 70,2 | 81,3 | 87,4 | 84,0 | 74,2 | 0,5 | 6,4 | 9,0 | 2,2 | 93 | 85 | 0,06 | o. | S. | S. | do | cum. | stratus.s.rn. |
| 23 | ,952 | ,031 | ,921 | ,903 | 74,6 | 77,0 | 91,2 | 82,0 | 73,0 | 2,6 | 4,4 | 10,1 | 5,0 | 93 | 81 | | o. | s. w. | w. n. | cumuli. | clear. | clear. |
| 24 | ,935 | ,056 | ,955 | ,008 | 67,0 | 77,8 | 90,0 | 80,5 | 73,2 | 1,8 | 5,7 | 10,0 | 5,7 | 90 | 80 | | n. e. | n. | n. w. | clear. | do | fog. |
| 25 | ,970 | ,055 | ,958 | ,031 | 70,0 | 76,4 | 88,0 | 81,1 | 70,2 | 6,2 | 6,7 | 11,5 | 5,2 | 87 | 77 | | n. | n. w. | n. w. | do | do | do |
| 26 | ,018 | ,084 | ,976 | ,048 | 67,8 | 75,5 | 85,0 | 81,0 | 74,2 | 3,8 | 6,0 | 10,5 | 6,2 | 90 | 80 | | o. | n. | o. | do | do | do |
| 27 | ,014 | ,087 | ,971 | ,026 | 69,2 | 78,2 | 84,0 | 80,0 | 74,2 | 3,8 | 7,2 | 8,8 | 6,5 | 88 | 82 | | o. | n. | o. | do | do | do |
| 28 | ,984 | ,068 | ,970 | ,015 | 69,1 | 75,8 | 84,1 | 81,3 | 73,5 | 3,1 | 5,7 | 9,2 | 3,9 | 90 | 85 | | n. e. | n. | o. | do | do | haze. |
| 29 | ,970 | ,093 | ,958 | ,012 | 68,6 | 77,3 | 85,0 | 80,7 | 70,8 | 1,1 | 5,6 | 9,3 | 6,1 | 92 | 81 | | o. | n. | o. | do | cumuli. | clear. |
| 30 | ,988 | ,050 | ,930 | ,967 | 66,0 | 74,5 | 84,0 | 80,3 | 69,0 | 3,3 | 7,4 | 13,5 | 8,0 | 86 | 72 | | o. | n. | o. | cirri. | do | fog. |
| Mean, | 29,953 | 30,029 | ,926 | ,978 | 70,3 | 79,0 | 89,2 | 82,1 | 74,7 | 3,9 | 6,9 | 10,1 | 6,3 | 88 | 74 | 0,06 | light day breeze. | | | steady fine. | | |

The instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory; those for 4½ A. M. and 10 P. M. in the south veranda of a third story near the cathedral. The Barometers both stand .044 lower than the Surveyor General's.

# JOURNAL

OF

# THE ASIATIC SOCIETY.

## *No.* 24.—*December*, 1833.

### I.—*A short Account of the Charak Púja Ceremonies, and a Description of the Implements used. By* Ram Comul Sén, *Native Secretary, Asiatic Society.*

[Read before the Asiatic Society, in 1829.]

In describing the instruments used in the *Charak Sanyása* presented by me for the Museum of the Asiatic Society, a short notice of the origin and practice of the ceremony appears to be necessary to illustrate the subject.

The word *Charak* is derived from *Chakra* or *Charaka,* which means a circle, and is used to signify moving or swinging in a circular direction; *Charak Sanyása* implies leaving off worldly business, living abstemiously, observing austerities, for the propitiation of *Siva.* It is a festival improperly termed by many *Charak Púja,* perhaps from the notion that every ceremony observed by the Hindus of Bengal, is a *puja* or religious worship; and whether it be performed by a *muchi* or *chandála,* is considered as Hinduism, and the whole body of the Hindus are charged with the absurdity of the act.

There are two kinds of *Sanyásas,* called *Siva Sanyása,* and *Dherma Sanyása*; the first is celebrated in the month of *Chaitra,* and the second in *Baisákha*; the people who practise these *Sanyásas* are termed *Sanyásis,* and the priest who presides in the ceremony is called a *Gajaneyá* brahman: the Charak festival is also called *Gajana,* (*Gá* or *Grama,* village; *jana,* people,) being observed by the villagers. There are several ranks amongst the *Sanyásis,* such as *Múla* or head; *Dhula,* or subordinate; *Sain,* or followers. The time occupied by the *Charak Sanyása* is a whole month, and that of the *Dherma* is a fortnight; during this time the *Sanyásis* live abstemiously, and observe various ceremonies to be noticed below.

This act is performed by the Sudra class only, and generally by the lowest castes and most dissipated characters; some of them consider it as an act of piety and religion, in commemoration of the austerities performed by Vana Raja, a king and Daitya, who by acts of self-torture and denial obtained the special favour of Maha'deva, and who first introduced the festival; but the greatest number engage in it as a lucrative exhibition, or from a desire to acquire a character for courage in the opinion of their friends. In some cases, the rite is compulsory: the parents make a vow to Siva, when involved in trouble and disasters, that their children shall perform *Sanyásas*, for a certain number of years, which the sons must fulfil.

The form and manner of *Sanyásas* varies: the original ceremonies consisted of,

1. *Phala Sanyása*, playing with fruits.
2. *Phula Sanyása*, do. flowers.
3. *Nila Sanyása*, worshipping Nilavati, a goddess.
4. *Jhula Sanyása*, hanging, and
5. *Charak*, swinging. These have been multiplied, and additions have been introduced by the people according to their fancy.

The original rules have mostly fallen into disuse, and new ones have been substituted, as convenience required. The time of *Sanyása* has been reduced from 30 days to 15, 8, 4, and 2, and in some cases only one day is taken. The ceremony which was called an act of piety, is converted into an occasion of dissipation, drinking, gambling, and acts of immorality.

The following are the ceremonies at present in practice:

1. *Phala Bhánga* and *Kánta Sanyása*, or falling upon the branches of prickly plants, spread on the ground, collecting them, as well as fruits, and living solely upon fruits: the *Sanyásis* go in company, and climb upon date and cocoanut trees, and collect fruits; when they come back to the place of Siva, with the fruits so collected, they throw and distribute the same; they also receive presents of fruits. Barren women resort to the place, on the occasion, and spread cloths, on which if by accident a fruit falls, they receive it with joy as an omen of their becoming pregnant through the favour of Siva; at the same season, the *Múla Sanyási* with his deputy goes into a forest, a burial place, or on the bank of river, &c. and there performs the worship of Yama (king of death), and presents, as offerings to the evil spirits, boiled rice and roasted fish.

*Pátá Sanyása.*—Falling from a scaffold erected before Siva, upon a row of *Batí* or knives. It is called *Háta Sanáysa* and *Gháti*

*Sanyása*, because the scaffold is erected in a market place, and on the bank of a river; afterwards when the *Sanyásis* return to the temple of SIVA, they lie on their backs, upon the bare ground, in a row, close to each other, and the *Gajanaya* Brahman passes over them, treading upon their breasts.

*Phúla Sanyása.*—Collecting and playing with fuel; which they often procure by plundering gardens, and carrying off railings, loose doors, window frames, &c. They then make a large bonfire in the evening, and jump and walk over the flame, and play with the burnt charcoal, throwing the same upon one another; this is also called *Aguna Sanyása.*

*Nila Sanyása*—is the worship of NILAVA'TI, a wife of SIVA: the *Sanyásis* visit Káligháṫ or temples of SACTI and SIVA, where they pierce their sides, tongues, and the skins of their foreheads. This is called *Bána Phorá*, and on the occasion they collect presents and gifts from the spectators, who far from encouraging these self-tortures, pay them something to get rid of the sight of their bleeding limbs.

*Jhúla Sanyása*,—is climbing upon a scaffold, hanging with the head downward, and making a fire below. The fire is fed with the powder of Indian pitch.

*Charak.*—Eating *Chehatu* or *bran*, and swinging on the *Charak Gách* or post, erected for the purpose. Among these *Sanyásis* there are several other ceremonies of note, some of which must be noticed here: *Khátuní*, shaking and turning the head, rolling about the shrine of SIVA, beating the forehead, sitting up all night, and singing *Tarja*, or songs addressed to SIVA; sometimes, but not always, in his praise. *Phúla ká dána*, extracting or receiving the flowers laid upon the Linga, which they think fall down at their solicitation; and prayers to the god, who is pleased to throw them down as a sign of affirmation or negation to the question made to him by the *Múla Sanyási*, or the priest for himself or on behalf of his friends. If the flower does not come down after a certain time, it is then supposed that the god is not propitiated, and the *Deyule*, (proprietor,) *Mandala*, (agent,) the *Múla*, (head,) and other *Sanyásis*, and sometimes the priest himself, are tied up by the hands, and suspended to the verandah, all round the shrine of SIVA, while the *Sanyásis* redouble their *Khátúní* before the idol, and the drummer beats his drum with all strength; the *Sanyásis* and others remain suspended from off the ground till the flowers fall. The flowers are at first laid upon one another, and then placed upon the top of the Linga, which is oiled, and is consequently slippery: water is thrown upon it by drops, which assists to wash off the flowers, and when it is obstinate, some person on the part of the priest, contrives to knock it off with a stick unperceived.

*Description of the Instruments used in the Charak, of which Specimens are deposited in the Museum and numbered accordinglg.*

*The Vetrasana* is an instrument made of ratan, No. 1: it means a seat of ratan, it is the staff of the *Sanyási,* a number of ratan folded in the middle and tied up together, leaving a few inches open in the lower part, in an oval form, the upper part is kept loose. Its use is various—it is a sacred ensign of authority, which must be respected on particular occasions by the *Sanyásis,* who rattle it as their musical instrument, in their procession; it is made a broom for cleaning the place of Siva, where the use of common broom is forbidden during the *Charak.* It serves as a weapon, with which they fight, or beat down the bundle of thorns used in the *Kánta Sanyása* upon which they fall; they use it in playing with the burnt charcoal in *Phula Sanyása;* it is used as ropes laid under the pot or bag No. 2, in the *Pat Sanyasa.* When any dispute or difference arises between the priest and *Sanyásis,* or when the latter in their procession meet with another party, they lay down the *Vetrasana* across the road and the entrance to the house of Siva, and the party against whom it is laid down must instantly stop; it is a sacred bar which they must not pass over without violating the law of *Charak,* and committing a sin which would disqualify them from becoming *Sanyásis* again. They are finally allowed to pass only in compliance with certain conditions; and certain questions relative to Siva, delivered in verses, called *Tarja,* must be likewise answered before the new comers are allowed to pass, and beat their drum, or do any business.

*Sutasana,* or a cord of twisted thread, No. 3; it is in two pieces, which they pass beneath the skin of the sides, arms and thighs; the ends are held by two *Sanyásis* or assistants, whilst the man dances and passes to and fro. This purpose is also answered by log-line, No. 4, ratan, No. 5, split bambú, No. 6.

*Dasnakhi,* (No. 7,) two pieces of iron rod, about 2 feet long: one end is pointed, which is passed into the sides, and the other is fork-shaped with prongs, each of which is called *nakha,* or nails, or finger-nail; the two pieces have often 10 nails, hence it is called *dasa-nakhi* or ten-fingered, but it is has often three prongs: the upper ends are flat, and laid upon one another, which serves as a bed for fire, or a lamp, made of cotton dipped in ghee; which is lighted, and upon this the powder of Indian pitch is from time to time thrown, so as to make a blaze, while the *Sanyási* dances as he goes.

*Bati,* or knife, No. 8.—Eight in number, fixed upon two pieces of boards, in a leaning posture, placed upon a bag, No. 2, stuffed with straw. This bag is held by four persons, aloft from the ground, and two *Sanyásis* join their *Betásana* No. 1, and lay the same across, to render to the bag additional strength, and the *Sanyásis* fall upon it from the scaffold, No. 9.

*Visesaya,* No. 10, or nails to the number of 120; one end is flat, the other is pointed and sharp, these are run into the skin of the forehead, upon both arms, and breast, in an ornamental form, close to each other, usually like the front or facing of a jacket. To the ends of the nails small beads or peas are attached or suspended like garlands hanging upon the forehead, and small pieces of talc are suspended by way of decoration.

fig. 1.

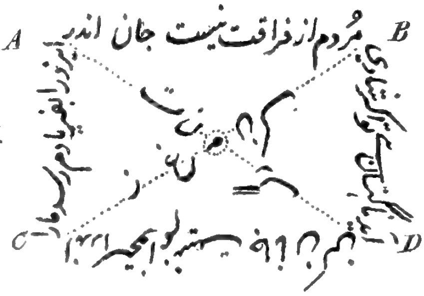



fig. 4.


fig. 3.

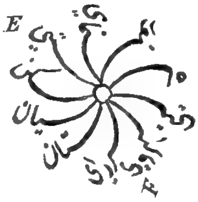



fig 2.

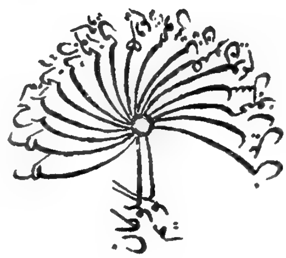


fig. 5.

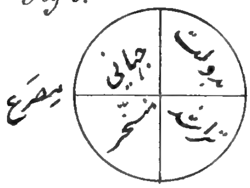



fig. 6.

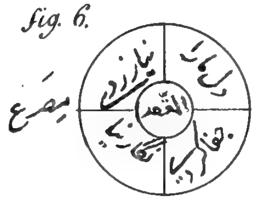



fig 7

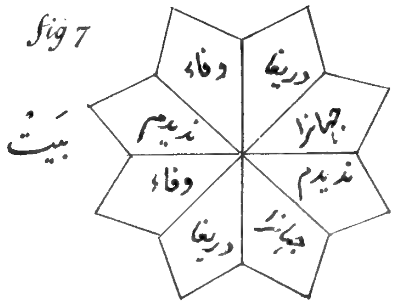


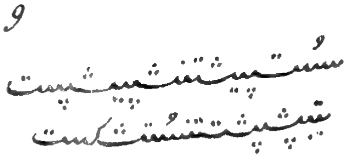

fig. 8.

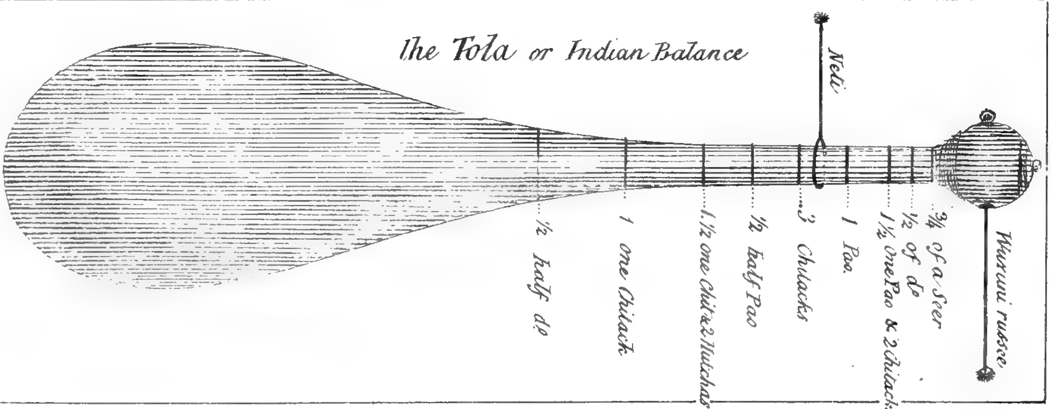
B

| | | | |
|---|---|---|---|
| بیمارم | من دایم | آن دلبر | از فرقت |
| بیدارم | یا دردم | کز عشقش | آندلبر |
| بی یارم | بی مونس | با دردم | من دایم |
| غمخوارم | بی یارم | بیدارم | بیمارم |

D

fig. 9





*Banas*, Nos. 11, 12, 13, or arrows, iron rods of various sizes and thickness, used according to the strength and courage of the *Sanyásis*, whose tongues and sides are bored, and the rods are let in, which they often move about. When it is perforated, the tongue and the rod rest upon the lower jaw, or are held between his teeth; if it be heavy, another person holds the ends.

*Kupali*, No. 14, is an iron rod or nail: the lower end is pointed, and is passed through the skin of the forehead, the man holding it close to his nose, or a bandage is tied round the head, to prevent it from falling; a small lamp is attached to its top, which he burns on the day of Nila.

*Charak kánta*, No. 15, or swinging hooks. The *Charakí*, or one who swings, is often of the bearer caste, and other people, not *Sanyásis*, volunteer for this act, through the effect of liquor.

The skin of the back being drawn out, a perforation is made with a lancet, No. 16, on each side of the back-bone, and the hooks, No. 15, are let in; the twine attached to the hooks is tied to the rope, suspended to the *Charak Gácha*, No. 17. If the skin of the *Sanyási* is thin, or he is weak, a bandage of cloth is tied round his chest, to prevent the hooks from giving way, as when they break the *Sanyási* falls, and is generally killed; the standers by also are sometimes severely hurt.

No. 18, 19, 20 and 21, *Belkars*, or lancets of various sizes and thickness: with these the skin is bored. These are not kept by the *Sanyásis*, but procured from certain *kumárs* (blacksmiths), who attend the place where the *Sanyásis* meet, and receive a certain fee, which varies from 2 annas to 2 rupees for each subject. The lancets are of various sizes, and a number is always brought by the operator.

*Nagapasa*, No. 22, two long pieces of iron, with a snake head, hooded top; two of these are run into the neck and back of the head, and brought down to the waist; each has two borings at least, one on the head skin and one on the back. The *Sanyási* whō can submit to this torture is considered a great hero, and when two similar ones are put in, he cannot turn or bend his body without breaking the skin through which they are bored.

There is also a head piece, No. 23, made of iron put upon the head; it has 3 to 5 pieces fixed to it like the hoods of serpents.

*Charak Gách*, No. 17, or a post, commonly of saul wood, for swinging: it is from 29 to 30 feet long, fixed into the ground, the upper part has a notch, or socket, called *Mocha*, B; in which a movable pivot is let in, called *Khakúyl*. On this, a cross piece made of bambús 5 to 10 in number is tied up together, and placed across the *Khakúyl*; to both ends of the cross thick ropes are suspended, one of which is tied to the hook, No. 15, and on which the *Charakí* swings.

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## II.—*Specimens of some Ornamental Forms of Persian Writing. By Mahá Rájá* Káli Kishen *Behadúr, of Calcutta.*

The accompanying figures, representing some beautiful poetical inventions of the latest authors, are extracted and translated from a Persian book called "*Mujmua-us-sanáyá*," (or Collection of Arts,) compiled by Nizám-ud-Dí'n Ahmed, son of Muhammed Sánih, in the year 1060, Hejri.

*Fig.* 1. (Plate xxi.) ألمعقوب *Ulmaáqúb*, or anagram that retains the same meaning, even when it is read in various directions.

In this, the central م (*m*) is the first letter of every hemistich. The reading will run equally well by beginning first from م towards B, thence continuing towards A, and from A returning to م; then back again from م to A; from A to C; and back again to م; further, from م to C; then from C to D; and finally from D back again to م.—Translation.

> " I am dead on your separation and have no soul in my body,
> For God's sake hear my sorrowful lamentation.
> I have no marrow in my bones, O love, be kind to me,
> Happy if I instantly die when separated from you."

*Fig.* 2. المشجر *Ulmoshojur ;* the arborescent form.

In this the Arabic letter *m* is round, differing from the shape of the Persian. م, placed in the centre of the circle of which the branches form radii, is the beginning of each word ; and the stars 1, 2, 3, 4, mark the end of as many hemistichs; the reading of the first begins semicircularly from B to C.—Translation.

> " I am fond of the curled locks of beauties,
> And I am captivated by their moon-like faces.
> I drink wine and am constantly a drunkard in the tavern,
> And I give thanks to the God of the heavenly kingdom."

*Figs.* 3 and 4. المعقد *Ulmoaqqad,* or the representation of knots.

From the central م commencing along either side at the letter E or F, and terminating where we set out, we shall arrive at the conclusion of two hemistichs.

The reading of either hemistich should be directed alternately from the right and the left hand, in order not to lose their respective sense and metre.—Translation.

> " Be not intoxicated, and do not go to the intoxicated ones,
> O thou possessed of moon-like face ;
> Do not display vanity like the brilliant moon.
> Thou hast charmed hermits, kings, and angels,
> Bewitched the beauties by thy moon-like face."

*Figs.* 5, 6, and 7. The beauty of the construction of these three figures is, that the reading may follow any order of the compartments without altering the sense.—Translation.

> " The world with its riches is under your subjection,
> O Love, it is tyranny that thou hast not afflicted my heart :
> Alas, there is no faith in the world; alas, there is no faith in the world."

*Fig.* 8. المربع *Ulmorabáa,* or a quadrilateral figure containing four hemistichs, and these are read in both horizontal and perpendicular directions, beginning either from any of the four upper compartments downwards, or from any of the four perpendicular compartments of B, D, sideways, from right to left; and the same verse will be found.

"I am in constant affliction owing to the absence of that ravisher of my heart;
That ravisher of my heart whose love keeps me awake with affliction.
I am constantly in pain without a companion and without a friend;
I am sick, I am awake, and without a friend and without a sympathizer."

*Fig.* 9 شکل اره *Shakl-i Arrah*, or saw-like form. The ابیات *Abeátí* distichs are read in the usual manner as follows:

سست پیش تنش تپش پست بتپش پشت تن سست شکست

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III.—*Description of an Indian Balance, called Tula. By the same.*

[Presented at the Meeting of the 31st July.]

This instrument is made out of common wood, but generally *Súndrí* (Herritiera minor) is used.

It is employed by the *Músulmán Kághazy*, or paper-makers, for the purpose of weighing old and useless papers; it is also used for weighing cotton, as well as thread, by native weavers of both sexes.

The marks of division around the beam are the indications of different weights, as particularized in the accompanying drawing.

The larger string, named *wazni-rassi* (or the string for suspending weights), is introduced through a perforation at the end of the beam; and the little *one*, termed *neti*, is for holding by the fingers to ascertain the weight, by applying it on one or other of the marks above alluded to.

The accompanying plate (Plate xxii. fig 8) is one quarter the ordinary size of the instrument, but some are a little larger, and others smaller.

It is in principle similar to the Roman steel-yard, the fulcrum shifting instead of the weight.

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IV.—*Abstract of a Meteorological Journal, kept at Kotgarh, (Lat.* 31° 18′ 45″ *N. Long.* 77° 27′ 49″ *E.) Subathú, and the intermediate places in the Himálaya mountains, for* 1819-20. *By Captain* Patrick Gerard, 9*th Regt. B. N. I.*

The voluminous nature of these journals, which were presented by Captain Gerard to the Asiatic Society some years ago, has hitherto prevented their seeing the light. The very circumstance which constitutes their value as a record,—the minute detail for every hour of the day, continued with little interruption by an indefatigable observer, for a period of two years,—having in the end thwarted his views and his reward, while they have deprived the scientific of a most valuable and will digested register of meteorological data. It would be impossible to devote space for their entire publication in the pages of this journal, but such an abstract as we have gleaned from many similar tables on former occasions, and which will suffice for most purposes of a general nature, especially for that we have hitherto kept in view,—the fixing of the *constants* of diurnal and monthly range of heat and pressure for as many points as possible on the continent of India,—we now with permission present to our readers : prefixing Captain GERARD's account of his instruments and of his method of observing.

"With regard to the tables which I now transmit, I beg to state that, generally speaking, the means of the observations, whether of the barometer or thermometers, attached or inside, and detached or outside, in the air and shade, taken during a march or halt or temporary intermediate place of encampment, are deduced from the highest during the day, and lowest the following morning, which will furnish a correct mean of the place for the day. The attached or inside thermometer at Kotgarh was rather open to a westerly aspect, the observations being taken in a room of the house to the westward, thereby shewing a somewhat higher temperature than if taken in a room towards the north. This was merely done for the sake of convenience. The detached or outside thermometer was suspended on a pole fixed in the ground for this special purpose, apart from the house, from day-break or early in the morning, to the north-west side for nearly half, and to the N. N. E. side for the remainder of the day, in the air and shade, to obviate as much as possible the sudden effects arising from reflection from the earth and the sun's rays in clear, settled, and hot weather; which would thereby indicate a higher, and consequently somewhat a more incorrect temperature of the air, than it otherwise ought to do, had it been hung at a considerable distance from any building better situated and free from the influence of all or any degree of reflection, so liable at all times to raise it above the true standard.

The barometer used duriug the two years, to insure accuracy as far as practicable in the instrument, was unexceptionable in every respect, being filled with pure mercury, carefully revived from cinnabar, by distillation in a retort, with the filings of iron, and gradually boiled over a slow charcoal fire from the sealed end upwards, which process is always tedious and difficult of accomplishment.

As not less than ten or twelve observations were taken and recorded daily with nicety, the correctness of the following tables may be relied on.

I possessed no instruments for ascertaining the density and humidity of the atmosphere, evaporation, or the quantity of rain which has fallen during the years under review. The winds stated as stormy, strong, brisk, steady, moderate, gentle, little, and light, have been estimated by their supposed strength unaided by a guage, to indicate their actual force. The same may be noticed in regard to the quality and appearance of the clouds.

The sudden creation and increase of clouds, spontaneously rising from dells and valleys, subsequent to rain and snow*, more especially during the periodical

* During the rainy months, the clouds, after rising, forming, and collecting, ascend to a certain altitude, and generally remain stationary, and frequently day after day about the same time come down again in rain.

rainy and winter seasons, on the hither or Indian side of the Himálaya range (the opposite or ultra side of the Himálaya being little subjected, and that only for a short distance into the interior, from the loftiness of this grand and extensive barrier of mountains separating India from other parts of Asia, to such a deluge), are more astonishing to the beholder than I have words to describe, and their total disappearance in a short space of time (sometimes indeed almost in a moment) is equally surprising. I have often remarked these without any apparent cause during calm settled weather, moving in all directions in heavy loose masses; at other times with incredible velocity, resembling spray, down a ridge or valley, till they reach a certain point, when they evaporate, and in an instant disappear. Sometimes they may be seen in all shapes and curious forms, and frequently they accumulate and disperse in a manner quite astonishing to the spectator. They will rest for days, and even weeks, upon the top, and the slopes of the high surrounding ranges and mountains, defining a clear outline around*, thereby condensing and confining the atmosphere within certain limits at an altitude of 8000 feet and upwards, (rarely at a less elevation for any time,) above two or three days, and making it close and sometimes unpleasant to the feelings, although the thermometer may indicate a low temperature at the time ; and often in clear, cloudless temperature and mild weather, small patches may be seen stationary in some places, and suddenly gliding along and up the declivity or slope towards the tops of the mountains, and dispersing quickly in others†.

The principal places at which any number of observations were taken are Rampúr, Kotgarh and Subathú. At intermediate places, during a march or temporary halt, the observations taken were recorded.

The latitude, longitude, and elevation above the level of the sea‡, together with the name of each village, town, and encampment, on the journeys made each year; the state in which comprised ; and to what authority now subject, will be found detailed in a table or " List of Places, &c." at the end of the abridgement, and other tables for each year.

The point of ebullition and the temperature of springs, rivers, and streams have not been omitted at most places in the subsequent sheets, during a journey. The utility of the former, when unaccompanied with a barometer, is too evident almost to need illustration. It will give a tolerable idea of the elevation of different stations; while the second, which were only ascertained at a few places, will nearly shew the mean temperature of the year at different altitudes ; and the latter will certainly, from the diminution of temperature, indicate a tolerable estimate of the distance of the source of the rivers in the water of which the thermometer may have been dipped, and an observation taken of its temperature. If rivers and streams indicate a high temperature, the source of them may reasonably be considered to be remote ; but if a low temperature be evinced, the contrary may be supposed to be the case. Certain local circumstances and influences may in some degree affect the temperature of rivers."

* These remarks apply to *Kotgarh* and its neighbourhood, and indeed from *Simla* upwards, as I can affirm from my own long observation.

† The sun's rays after rising have in general this effect.

‡ For these on the present as well as on the former occasion I am indebted to my brother, Captain A. Gerard, late Surveyor in Rajputana and Malwa ; and for a few of the latter, and partly some of the observations of the barometer and thermometer during my occasional short visits to Subathú, to my brother Mr. J. G. Gerard, Surgeon to the 1st Nassiri battalion, stationed in these mountains.

*Summary of Captain P. Gerard's Meteorological Registers for* 1819-20.

| Place. | Month. 1819. | Barometer 32°. max. at 10 A. M. | min. at 4 P. M. | mean. | Temperature in the house. max. | min. | mean. | Temperature outside, in the shade. max. | min. | mean. | Winds, no. of days in each direction. Ne. | E. | Sw. | W. | Average force of the wind. | Weather. Clear. | Fair, Cloudy | Rain & snow. | Storms. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kotgarh, ... | Jan. 8 to 31 | 23.585 | .557 | .568 | 40.6 | 35.9 | 38.3 | — | 30.6 | — | 3 | 10 | 4 | 13 | gentle | 16 | 8 | 7 | 1 | Generally fine; snow. |
| Ditto, ...... | Feb. 1 to 28 | .699 | .650 | .675 | 44.7 | 41.2 | 42.5 | 42.9 | 33.8 | 37.6 | 3 | 13 | 1 | 11 | ditto | 11 | 8 | 9 | 1 | Fair with storms. |
| Subathú, .... | Mar. 1 to 28 | 25.909 | .855 | .872 | 67.9 | 59.9 | 63.8 | 73.5 | 55.2 | 64.4 | 7 | 0 | 21 | 0 | moderate | 18 | 7 | 3 | 3 | Clear and fine. |
| Ditto, ..... | Apr. 11 to 30 | .814 | .747 | .780 | 73.2 | 67.1 | 70.1 | 80.8 | 59.6 | 69.8 | 3 | 0 | 15 | 1 | steady | 15 | 0 | 5 | 4 | Clear with squalls. |
| Kotgarh, ... | May 11 to 31 | — | — | — | 63.1 | 60.2 | 61.6 | — | 50.3 | — | 0 | 16 | 4 | 11 | light | 12 | 5 | 14 | 8 | Clouds gathering. |
| Subathú, .... | June 5 to 30 | .706 | .626 | .662 | 81.3 | 76.7 | 79.0 | 84.3 | 70.5 | 77.9 | 5 | 7 | 10 | 7 | strong | 9 | 10 | 10 | 8 | Fair and rainy. |
| Kotgarh, .... | July 2 to 31 | 23.559 | .508 | .535 | 73.1 | 67.1 | 69.2 | — | 60.3 | — | 1 | 21 | 2 | 7 | light | 2 | 10 | 19 | 5 | Cloudy and rain. |
| Ditto, ...... | Augt. entire | .518 | .471 | .494 | 71.3 | 66.3 | 68.8 | — | 60.2 | — | 2 | 19 | 0 | 10 | ditto | 1 | 9 | 21 | 5 | Much rain. |
| Marching, ... | Sept. do. | — | — | — | 65.0 | 57.0 | 60.9 | — | 51.5 | — | — | — | — | — | ditto | 2 | 6 | 22 | 4 | Ditto. |
| In mountains, | Oct. irregular | — | — | — | 60.0 | 50.0 | 55.0 | 50.0 | 30 0 | 40 | — | — | — | — | gentle | 20 | 5 | 6 | 0 | Fair weather. |
| Kotgarh, .... | Nov. 16 to 30 | .724 | .661 | .693 | 49.5 | 47.1 | 48.3 | — | 37.2 | — | — | 6 | — | 8 | ditto | 22 | 5 | 3 | 1 | Clear, fine. |
| Ditto, ...... | Dec. 1 to 25 | .744 | .680 | .711 | 46.6 | 45.6 | 46.1 | — | 39.3 | — | 4 | 16 | 8 | 3 | light | 11 | 13 | 7 | 1 | Fair, cloudy. |
| | | | | | | | | | | | 28 | 108 | 65 | 71 | | 139 | 86 | 126 | 40 | |
| | 1820. | | | | | | | | | | | | | | | | | | | |
| Travelling, . | Jan. 11 to 22 | .653 | .601 | .627 | 41.1 | 40.0 | 40.6 | — | 36.2 | — | 7 | 7 | 7 | 2 | light | 26 | 3 | 2 | 2 | Clear. |
| Kotgarh, .... | Feb. 9 to 29 | .619 | .563 | .589 | 45.4 | 43.7 | 44.6 | — | 36.8 | — | 6 | 7 | 2 | 14 | gentle | 14 | 6 | 9 | 1 | Clear snow. |
| Ditto, ...... | Mar. 1 to 15 | .718 | .648 | .686 | 52.2 | 50.6 | 51 4 | — | 43 5 | — | 6 | 3 | — | 6 | ditto | 17 | 5 | 9 | 4 | Ditto showers. |
| Ramgarh, ... | Apr. | — | — | — | 75.6 | 59.0 | 67.5 | — | 50.9 | — | — | — | — | — | ditto | 14 | 4 | 12 | 5 | Fair and do. |
| Kotgarh, .... | May 11 to 31 | .600 | .526 | .559 | 66.4 | 63.6 | 65.3 | — | 54.5 | — | 1 | 6 | 2 | 11 | ditto | 15 | 8 | 8 | 5 | Storms and fair. |
| Ditto, ...... | June entire. | .489 | .432 | .461 | 72.1 | 68.0 | 69.8 | 78.1 | 60.5 | 70.0 | 1 | 13 | 6 | 10 | moderate | 10 | 9 | 11 | 5 | Cloudy and do. |
| Ditto, ...... | July do. | .496 | .435 | .455 | 71.4 | 66.1 | 69.4 | 77.4 | 61 4 | 69.9 | 5 | 20 | 2 | 4 | light | 0 | 3 | 28 | 2 | Much rain. |
| Ditto, ...... | Augt. 1 to 21 | .542 | .467 | .509 | 71.4 | 68.0 | 70.5 | 75.0 | 61.0 | 68.0 | 5 | 13 | 1 | 5 | ditto | 0 | 9 | 22 | 2 | Ditto. |
| Ditto, ...... | Sep. { 8 to 12 / 20 to 30 | .550 | .492 | .522 | 69.3 | 64.6 | 66.7 | 72.1 | 56.8 | 64.5 | 1 | 16 | 0 | 6 | ditto | 6 | 11 | 13 | 2 | Clearing. |
| Ditto, ...... | Oct. entire. | .668 | .596 | .639 | 62.5 | 56.9 | 59.7 | 63.2 | 48.9 | 56.8 | 0 | 17 | 2 | 12 | ditto | 20 | 5 | 6 | 3 | Fine weather. |
| Th. Rampúr, | Nov. 1 to 4 | .662 | .613 | .637 | 74.8 | 57.3 | 66.1 | 73.4 | 43.2 | 58.7 | 9 | 1 | 19 | 1 | gentle | 18 | 7 | 5 | 1 | Clear and clouds. |
| Rampúr, ... | Dec. 3 to 31 | — | — | — | 51.4 | 44.8 | 49.4 | 63.9 | 37 4 | 50.7 | 5 | 0 | 25 | 1 | ditto | 17 | 10 | 4 | 0 | Ditto. |
| Annual average at Kotgarh, .... | | 23.624 | .562 | .593 | 58.6 | 55.4 | 56.9 | 63 ? | 47.7 | 56 ? | 46 | 103 | 66 | 72 | | 157 | 80 | 129 | 32 | |

With exception of the month of April, so inviting to a resident in the hills for expeditions into the higher and more remote parts of the vast Himálayan range, we find in the foregoing abstract, besides three months at Subathú, a nearly complete annual series of barometrical observations for Kotgarh, a station more than 6000 feet elevated above the sea*, and far enough within the first range of hills to obviate the effects of the currents of air from the plains, as observed in the Dehra Dún by Dr. ROYLE†. It must not be expected that the regularity observed on the level continent of India will be found in the march of the barometer in a mountainous country, where fluctuations of temperature, moisture, and wind are much more frequent and sudden than in the plains; still the same general curve obtains through the year, and the diurnal rise and fall is regular and of the same nature as in the plains, not a negative oscillation as is observed at great elevations on the Alps. The average diurnal oscillation or fall from 10 A. M. to 4 P. M. is 0.063 inch: to which adding one-fourth (or, as 30 in. to 23 in.) to render it comparable with the oscillation under a pressure of 30 inches, we have .079, which is only two-thirds of the daily oscillation at Seháranpúr‡, as deduced from Dr. ROYLE's registers; we may therefore conclude that at a greater elevation, we should observe a still further decrease until, passing zero, the diurnal oscillation would become negative; that is, the barometer would *rise* from 10 A. M. to 4 P. M. as observed at the convent of ST. BERNARD's. The solution of this curious question and the determination of the *zero or no oscillation* altitude, may probably be obtainable from the journals of Captain GERARD or his brother, Dr. J. G. GERARD, who is known to have reached an altitude of 17000 feet, barometer in hand; and we may confidently trust to their joint exertions in elucidation of it: for one fact of this nature estabished on certain data will better repay their labours in the course of meteorology than even a lengthened series of ordinary observations.

The thermometrical range out of doors is incomplete, the minimum only being registered: there cannot however be a wide difference between the monthly *mean*, in-doors, and in the open air. The monthly variations deduced from the latter column, (the monthly mean's) or from the column of exterior minima, give nearly the same annual curvature. The following table (column G) takes it from the interior mean. April and October are the two average months for temperature as well as for pressure, but the months of January and February present an anomaly in the barometer being lower than usual for those months in both the years under review.

* 6915 feet, by Capt. HERBERT, As. Res. xiv. 336; 6600 by subsequent correction, vol. xv. 413.

† See his note on the hour of maximum temperature in the hills, Jour. As. Soc. vol. i. p. 97.

‡ Journal, i. 30.

*Table of the mean Monthly and Diurnal Range of the Barometer and Thermometer at Kotgarh in* 1819—20, *(the month April being interpolated,) deduced from Captain Gerard's journals.*

| Month. | Barometer. | | | Thermometer. | | | | |
|---|---|---|---|---|---|---|---|---|
| | A. Mean height. | B. Deviation from mean annual height. | C. Mean diurnal oscillation. | D. Mean of minima in the open air. | E. Mean of maxima in doors. | F. Mean temperature in doors. | G. Deviation from mean annual temperature. | H. Mean diurnal range (e.—d.) |
| | in | in | in | o | o | o | o | o |
| January,.. | 23.592 | —.001 | 0.052 | 33.4 | 40.9 | 39.5 | —20.4 | 7.5 |
| February, | 632 | +.039 | .052 | 35.3 | 45.0 | 43.5 | —13.4 | 9.7 |
| March, ... | .686 | +.093 | .062 | 43.5 | 52.2 | 51.4 | — 5.5 | 8.7 |
| April, .... | .623 | +.040 | .067 | 47. | 58. | 57. | + 0.1 | 11.0 |
| May,..... | .559 | —.034 | .074 | 52.4 | 64.7 | 63 4 | + 6.5 | 12.3 |
| June,.. .. | .461 | —.132 | .068 | 60.5 | 72.1 | 69.8 | +12.9 | 11.6 |
| July,..... | .495 | —.098 | .061 | 60.8 | 71.4 | 69.3 | +12.4 | 10.6 |
| August,... | .501 | —.092 | .062 | 60.6 | 71.4 | 69.6 | +12.7 | 10.8 |
| September, | .522 | —.071 | .058 | 54.2 | 69.3 | 66.7 | + 9.8 | 15.1 |
| October,.. | .639 | +.046 | .072 | 48.9 | 62 5 | 59.7 | + 2 8 | 13.4 |
| November, | .693 | +.100 | .063 | 37.2 | 49.5 | 48.3 | — 8.6 | 12 3 |
| December, | .711 | +.118 | .064 | 39.3 | 46.6 | 45.0 | —11.9 | 13.3 |
| Mean, .... | 23.593 | range .250 | .063 | 47.7 | 58.6 | 56.9 | range 33.3 | 11.3 |

In the column (c) of mean diurnal barometric oscillation, the observations at Subathú have been included, as producing a better average; the difference of altitude will in this case have but a trifling influence on the result.

Appended to Captain P. Gerard's tables are catalogues of the latitude, longitude, and barometrical altitude of all the most important points visited in the course of the journeys, whose occurrence is marked by the blanks in the foregoing register. The journey of September, 1819, was made in company with the late Captain J. D. HERBERT, to survey the course and level of the river *Satlej*, of which an interesting account is published in the fifteenth volume of the Asiatic Researches. The heights were partly taken trigonometrically, but the majority by the boiling-point method, and a correction of two degrees and upwards was forced to be applied to the instrument used by Captain HERBERT, on account of an error deduced experimentally from a comparison of its boiling point with the height of a barometer filled with pure mercury, and well boiled, by Captain GERARD; DALTON's Table of Tensions were used in calculating the volume of the thermometric indications. The latter officer, in his remarks upon the tables before us, explains that his own thermometrical heights were taken with a different instrument, which did not require correction, and that they were calculated by his brother, Captain A. GERARD, on the supposition of the sea level being represented by 30 inches, or 212°. A deduction of 200 feet may in some cases be necessary on this account, but it will hardly affect the *relative* measurements, especially as the trips were made in April, September, and October, the months, as before stated, of mean barometrical altitude.

The following table contains a selection of some of the principal results of this part of the journal, and if compared with that printed in the Researches, it will be seen to afford the highest confirmation to Captain Herbert's statement; the altitudes and longitudes are from the latter.

In 1820, our author went alone by another route, and made some additions to his list of altitudes. The whole ought to be published, but they would require the elucidation of a route-map and notes of the journey.

On both occasions also, the temperature of rivers and springs was carefully noted, and a sure indication was thence deduced of the distance, direction, and source of the stream; a few of these are inserted below:

*Extract from Captain Gerard's Table of Altitudes.*

| 1819. Place. | State. | Latitude. North. | Longitude. East. | Boiling Point. | Elevation above the Sea |
|---|---|---|---|---|---|
| Rámpur, capital, | Bussáhir, | 31° 27′ | 77° 38′ | 206,8 | 3398 ft. |
| Nirtnagar, village, | Do. | 31 22 | 77 33 | 206,6 | 3087 |
| Kotgarh, cantonment, | British, | 31 19 | 77 30 | 200,7 | 6634 |
| Komharsén, capital, | Komharsén, | 31 19 | 77 27 | | 5500 |
| Subathú, encampment, | British, | 30 58 | 76 59 | | 4505 |
| Manlig, encampment, | Patiála, | —— | —— | | 4400 |
| Semla, do. | Keonthul, | 31 6 | 77 11 | | 7200 |
| Wartú fort, | Several, | 31 14 | 77 31 | | 10656 |
| Pabar, river near Raingarh, | British, | 31 8 | 77 46 | 202,7 | 5700 |
| Rontan, village, | Do. | 31 7 | 77 48 | 198,5 | 8900 |
| Encampment in Klashél range, | Bussáhir, | —— | —— | 194,1 | 12900 |
| Jáko Peak, | Do. | —— | —— | 196,1 | 9100 |
| Crest of Rúpen Pass*, | Do. | 31 21 | 78 10 | 185,7 | 15460 |
| Murang, | Do. | 31 36 | 78 27 | 197,4 | 8503 |
| Shipké, in Chinese Tartary, | Tibet, | 31 48 | 78 45 | 193,8 194,0 | 10597 |
| Hupshang, boundary between | Busahir&Tibet | 31 48 | 78 41 | | 10989 |
| Náku, village, | Bussahir, | 31 53 | 78 38 | 191,7 | 12005 |
| Sheálkhar, village and fort, | Do. | 32 | 78 35 | 194 | 10403 |
| Kánam village, | Kunáwar, | 31 40 | 78 27 | 197,2 | 9000 |
| Wangto jhula, bridge over the | Satlej, | 31 32 | 78 1 | 203,3 | 5200 |
| Dalnagar, village, | Bussáhir, | 31 23 | 77 36 | | 3200 |
| 1820. | | | | | |
| Mandar Ghátí Pass, boundary, | Do. | 31 16 | 77 38 | | 9800 |
| Sirarú Pass, | Do. | 31 10 | 77 37 | | 8885 |
| Purag, | Kotgúrú, | 31 7 | 77 30 | | 6900 |
| Nágkanda Pass, | | 31 15 | 77 28 | | 9016 |
| Dubalda range, | Kuranglu, | 31 17 | 77 35 | | 7300 |
| Top of Nankhar range, | Bussahir, | 31 17 | 77 37 | | 7800 |
| Búchkàl, on ascent to | Shatul, | 31 22 | 77 56 | | 11700 |
| Crest of left peak towards Shatul or | Rol Pass, | 31 23 | 77 55 | | 13300 |
| Chandídhar range, | Do. | 31 16 | 77 56 | | 9200 |
| Kujean, village, Jangleg, | Bussahir. | 31 18 | 78 1 | | 9250 |
| Kepu, bridge over Satlej, | British, | 31 21 | 77 28 | | 2800 |

* This pass is called the *Gunas* Pass by Capt. Herbert, (As. Res. xv. 413,) by mistake—the Gunas is another passage across the Himálaya, lying to the westward of the Rupen River.—P. G.

*Temperature of Rivers, Springs, and Torrents observed.*

| | | | |
|---|---|---|---|
| | 1819. | | ° |
| Spring between Phagao and Theog, | 8th May. | 7 A. M. | 45,2 |
| Stream on Klashél Range, | 24th Sept. | 11 A. M. | 45,5 |
| Rupen River, below Pass, | 29th | 9 A. M. | 40,5 |
| Satléj River, below Shipké, | 15th Oct. | 5 P. M. | 51,3 |
| Do. at Namghea jhúla, | 22nd | 9 A. M. | 44,0 |
| | 1820. | | |
| Beru Naddí or Torrent, | 4th Jan. | 9 A. M. | 33,1 |
| Grassu and Badí Torrents, | 5th | $8\frac{1}{2}$ A. M. | 29,5 |
| Chegaontí River, | 9th | $8\frac{1}{2}$ A. M. | 33,6 |
| Pabar River, near Mandlí, | 23rd Mar. | 5 P. M. | 52,7 |
| Andrí near Chírgaon, | 24th | $7\frac{1}{2}$ A. M. | 43,0 |
| Gop and Chílu Torrents, | 30th | 9 A. M. | 43,0 |
| Sepon River, | 30th | 10 A. M. | 40,1 |
| Pabar River, near Raingarh, | 7th Apr. | $6\frac{1}{2}$ A. M. | 51,8 |
| Shillar Torrent, | 20th | 6 A. M. | 47,0 |
| Tons River at conflux with Pabar, | 25th | 7 A. M. | 57,0 |
| Shalwe River, | 2nd May. | 6 P. M. | 69,9 |
| Couflux of Shalwe and Kholte Rivers, | 5th | 7 A. M. | 56,0 |

J. P.

## V.—*Notes on the Specimens of the Kankar Formation, and on Fossil Bones collected on the Jamna. By Captain* E. Smith, *Bengal Engineers.*

[Read 26th December.]

Captain E. Smith has been engaged for some years in removing the obstructions to navigation in the river Jamna, between Allahabad and Agra. These obstructions, as is well known, consist of sandstone rocks and *kankar* banks, protruding from the bed of the river at several points, leaving, at low water, dangerous bars but partially concealed, and causing rapids and whirlpools, which have proved in years past highly destructive to boats. In the course of this important duty, of which we hope hereafter to be able to give a full account, the peculiarities of the *kankar* formation, which has been the subject of so much speculation to Indian geologists, have been strongly impressed on his observation, and he has very laudably preserved sketches and remarks of their most remarkable appearances in his note-book, which he has now submitted with the series of specimens to the Society. "They are not numerous"—he writes, "having been taken only where differences in the *kankar* and rock were evident, but they form a regular series from Agra to Allahabad, shewing the nature of the rocks occurring throughout that distance. Having little knowledge of the subject myself, I have not attempted descriptions of the specimens, which will be more correctly recognized by others, but have substituted what may be of use, viz. sketches and notes of the exact situations whence the specimens have been obtained. These even amount to little more than indications of place, for almost the remarks that have offered themselves have been reserved until I know whether they will be of service."

All geologists will agree that the graphic mode of illustration adopted by Captain Smith is the very best for communicating at once an acquaintance with the nature of the country he has explored, and though confined to the banks and bed of a river, it must be remembered, that the section thus opened to him by the operations of nature, to a depth in some places of 100 feet or more, is a section of the great alluvium of the Doab and of the Agra plains, and not, as it would be in the lower course of the Ganges, a mere exhibition of the continually shifting channel and sands of the comparatively recent delta.— This remark extends particularly to the fossil bones discovered at Karimkhún and other places, which will be seen, as we proceed, to belong to the genuine class of fossils, underlying the *kankar* stratum of the clayey alluvium, and are not merely casual deposits in the present river, as Captain Herbert was led to suspect when their existence was first pointed out, in a situation of the same nature, near Calpí, by Doctor Duncan, in 1828*.

Dr. Royle also brought away a fragment of bone in 1831, and expressed his opinion that fossils would be found in the banks of the Jamna, (Journal, vol. i. 457.)

Regarding the present collection of fossil bones, Captain E. Smith's private letter furnishes the following particulars : " With the specimens of rock there is a box of fossils ; I have done little more than indicate the localities, with a few remarks on the state of the bones, originating in

* See Gleanings in Science, i. 23.—*Account of fossil elephant bones found in the river near Calpí.* As no further notice was taken, at the time, of Dr. Duncan's discovery, I take this opportunity of publishing the extract from Mr. J. Leslie's letter which brought the subject to the notice of the Physical Class of the Asiatic Society.

" I had the pleasure of sending you on the 6th, two portions of the fossil bones of an elephant, for which I am indebted to my friend Dr. Duncan at Calpí ; the following is an extract from his letter which accompanied them : 'The spot on which these remains were found is nearly three miles up the river on the opposite side to Calpí ; at the time of visiting them there was not a long bone whole ; probably a tooth might have been procured, but certainly not now, the remains being scattered by the natives who accompanied us, in all directions. I however send you what I preserved, part of a long bone (the femur) and a portion of a tusk, the lamellated structure of which is very distinct. The remains lay about 40 yards from the edge of the water, then very low, but which during the rains must evidently overflow the spot to an equal or greater extent. They appeared but superficially imbedded in the slightly coherent earthy stratum, which has been deposited by the waters on a bottom of *kankar*, of which the bed and banks of the river were here composed.' "

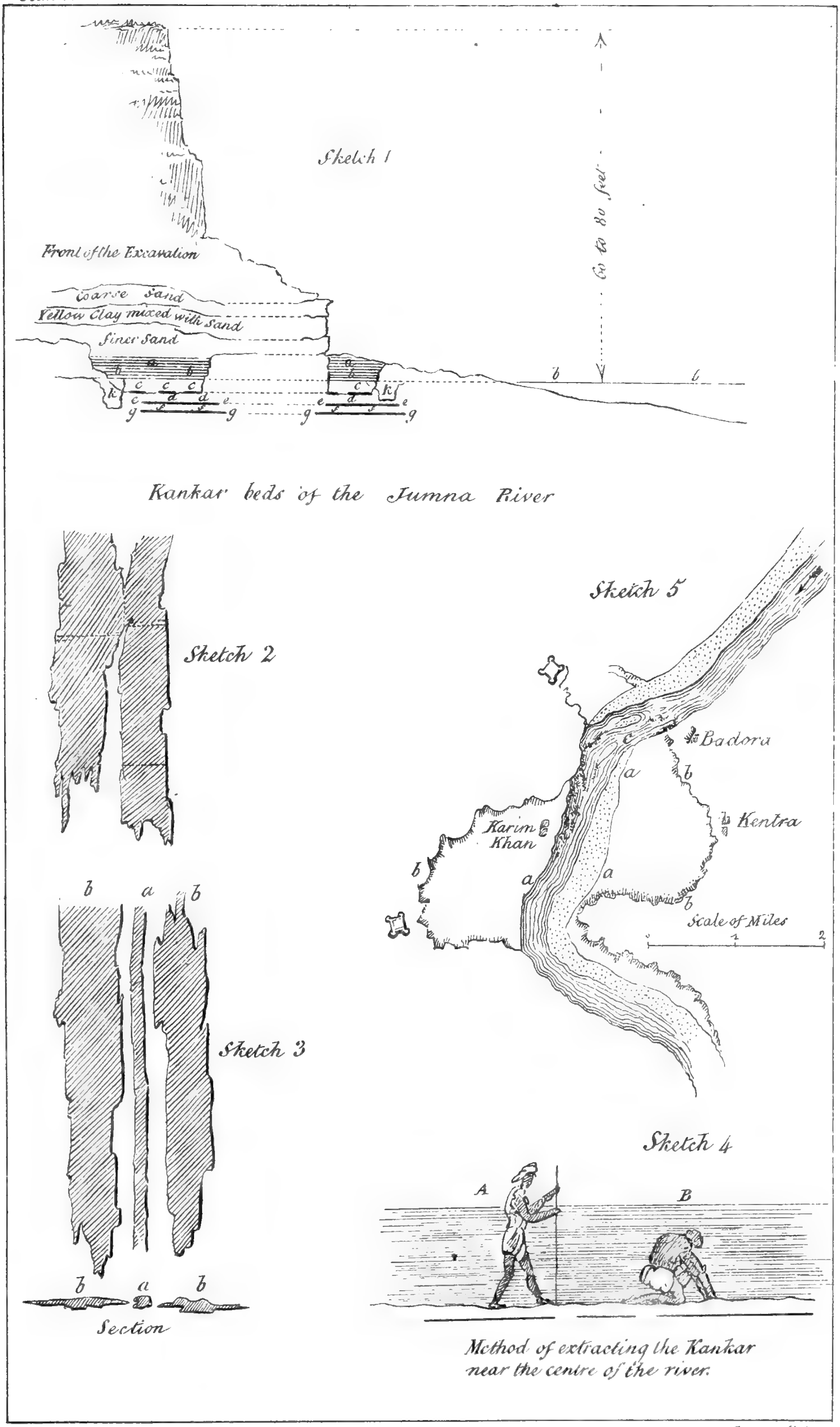
my acquaintance with the situations in which they are found. The portion of the subjoined note in which the fossils are assigned to different parts of the skeletons of various animals, has been derived from better authority than I can pretend to in such questions. From what has been obtained in the last year or two, it seems that fossils in great abundance are lodged in the bed of the river. They have in previous years of the works been procured in smaller quantities, from rocks or shoals differing in nature from those of the last season, having been removed in the first periods. One cause of so many having been of late discovered has been the presence of intelligent European overseers, whose curiosity has been excited by remains which were matter of indifference to the natives. It is to be regretted, however, that the attention of the men was not directed earlier to the preservation of these fossils.

"I became acquainted with their discovery in such quantities, and of such dimensions, only after an absence from the spot, during which the excavation had been completed, and could then collect merely a few of the fragments, which an interest in the subject on the part of some of the sergeants had induced them to select. Much however has been lost, and as seen in the list, a small piece only was kept of the shoulder blade of an elephant, (No. 3,) described as very perfect, but which unfortunately, with the rest of the mass removed from the shoal, was thrown into the water of a deep channel. I have lately got some more fossils, and in the course of the cold season, I shall have an opportunity of visiting some, of the existence of which in the banks of the river I have just had information, and which (if the account I have received be correct) would seem to prove that the process of petrifaction is still active."

Captain Smith has divided his notices under three heads, which we here insert in the same order, adding the characters of the rocks, and in some places their analysis, from the specimens presented to the Society.

### I.—*Notes with Explanatory Sketches on a Description of Kankar found in Slabs in part of the bank of the Jamna.* (*Plate* XXIII.)

A description of flag, composed of sand coarsely but strongly cemented, in thin slabs, horizontally disposed, is found in considerable quantities at a short distance from Kárímkhán, near Oreyah, on the Jamna. The situations from which it is usually dug are shown distinctly in the accompanying sketches, with the references and notes; but the flag is not confined to the banks of the river, (Sketches 1st and 5th,) being raised as well from sand-banks far out towards the centre of the bed of the stratum.




Cap. E. Smith. Eng. del.                J. B. Tassin lith.

It is excavated principally by the boat and ghat men, or the villagers of the *Mallah* class, on the immediate spot; and the search for it, and the mode of raising it, is simple.

In the hot months, when the river is low, these men observe what parts of the bank have been left by the river (Sketch 1st) so bare of sand, or deposits of mud, as to allow of a probability of the flags being reached without much labour in the removal of the superincumbent body. They are, from the excavations in former years, acquainted with the spots in which they may expect to find the flags, and the upper mass being cleared away, if the flags are reached, the excavation is carried on as long as the easy slope of the bank allows of its being profitable. It is generally from about the bottom of the bank, at the level of the lowest fall of the river in the dry months, that the flags are taken, and they are traced at all heights from this level up to 20 or 25 feet above it, but rarely or never higher. Below this lowest level, they are found in depths as great as the water has allowed of the excavation being prosecuted in, but that is not more than 4 or 5 feet. Towards the centre of the river they are raised from similar depths below the surface (Sketch 4th) from a space on which sand settles annually over a greater or less extent. Whenever any part is perceived free of sand, and the flags felt at the bottom of the water clear of that obstruction, they are detached by common iron implements, and raised. As is the case near the shore, the depths from which they are lifted do not exceed 4 or 5 feet. In raising the flags, it is usual to cut them across, (Sketch 2nd,) to reduce them to manageable dimensions, and as they are sometimes connected with each other at the edges, they are there too cut asunder. They are generally taken out in lengths of from 2 to 4 feet, the breadth varying from 1 to 2 feet.

Long round pieces are sometimes found between the flat slabs, (Sketch 3,) that is of course when the latter are not so close as to be connected. These round pieces are always smooth, never knotted, at least as those common on the surface of the kankar banks and shoals usually are. The round are always met within the horizontal line between the flat pieces, never above or below them, not even when there are double or treble strata of slabs. The directions of the lateral divisions of the slabs, as also of the grooves which channel the surfaces of both the flat and round pieces, is stated to correspond nearly with that of the present course of the river. These flags are said to harden on exposure to the air. It is unusual to find, in other parts of the bank, fine sand, similar to that of the sand strata immediately adjoining the flags, and to that of flags themselves*. It seems to be of a kind peculiar to this bank of the river, about the lowest level. Cursory observation at least does not discover it elsewhere. It is darker and greyer, but otherwise not unlike the fine sand of the superficial beds. Flags, it is asserted by the people, are never found on the sites of former excavations, that is, they believe them to be old deposits, and have no expectation of discovering fresh formations in the spots from which they have once before raised the layers. Projecting eaves from the roofs and windows of the native pakka houses are in this neighbourhood very generally constructed with these flags. It seems to be the use to which exclusively they are applied, and they are conveyed for it to *Calpí* and other towns in the vicinity, where they are sold at a few rupees a hundred.

Similar flags to these may very possibly exist on other parts of the bank of the river, but they have never been observed or heard of except at this place, and here but in one bank of about half mile in length, and in the bed of the river opposite to it. Although, as shewn in Sketch 5, this is now the main bank of the river, it has not always been so. At some very remote period, the Jamna must have ran along the foot of the higher plain on which *Kentra* stands, and which line, with the relative distances and elevations, is seen on the small sketch.

*References to the Sketches.*

*Sketch* 1. a. Sand in strata, alternating in thicknesses of the flags.

b. Lowest level of the river.

k. Cess-pool for baling out the water.

c. First stratum of flags.

d. Intervening layer of sand, fine, of the same color and description apparently as that in the composition of the flags, varying in thickness from 6 in. to 1 feet.

e. Second stratum of flags.

f. Second intervening layer of sand.

g. Third stratum of flags.

From 1 to 5, strata of flags and intervening sand are found.

*Sketch* 2. The slabs in their natural position, in the sand or the river. - - - - Cuts made by the people to detach them.

*Sketch* 3. Plan and section shewing the round pieces of kankar (*a*) found lying between the flat slabs (*b b*).

*Sketch* 4. The method of obtaining the kankar from the sand-beds towards the centre of the river.

A. One of the men separating the pieces by a sharpened crow-bar.

B. Another lifting up the detached pieces from the bottom.

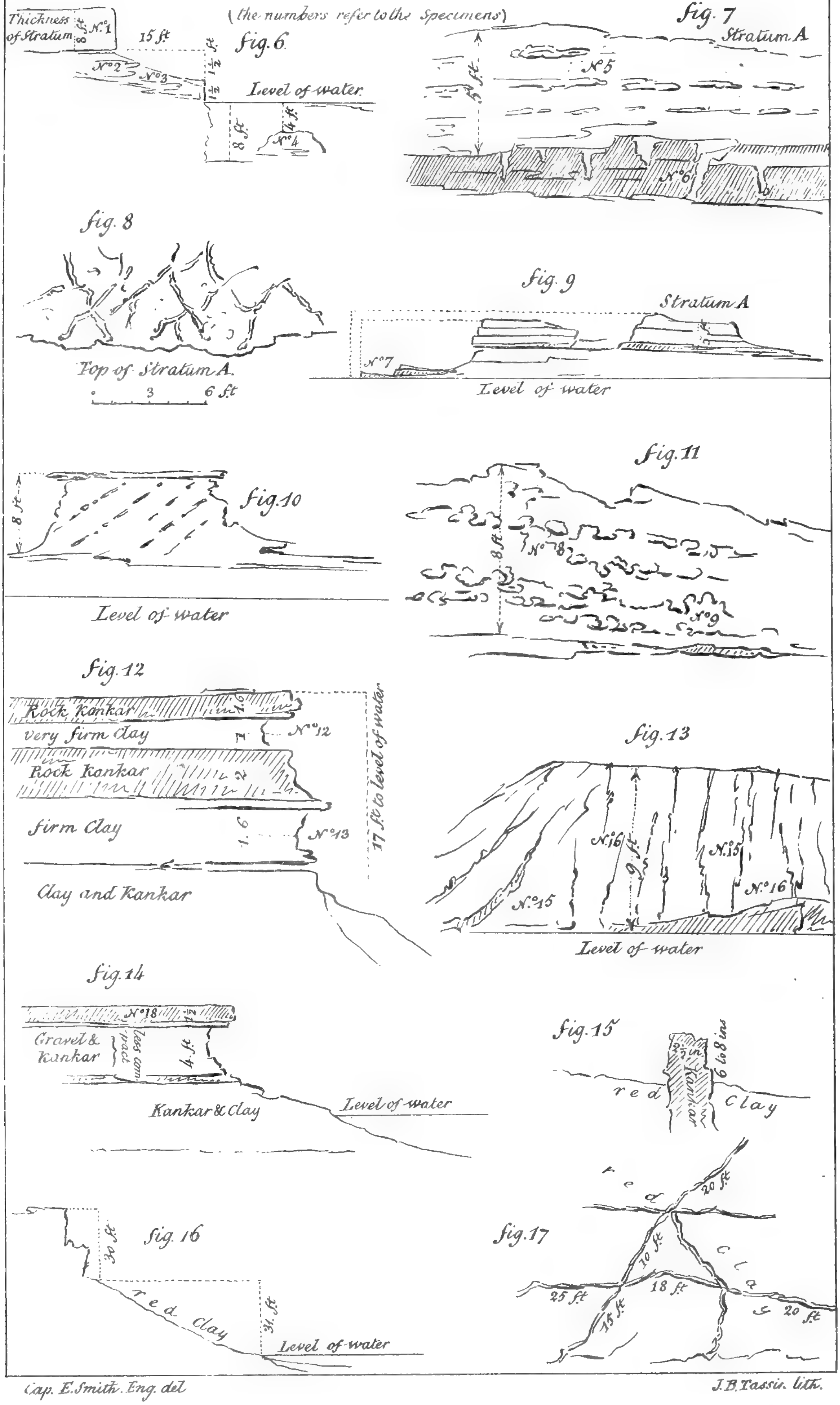
* The composition of the flag kankar analysed by me was as follows :

| | |
|---|---|
| Carbonate of lime, .......... | 42.2 |
| Fine sand, ................ | 57.8 |
| | 100 |

ED.

Varieties of Kankar in the Banks of the Jumna

(the numbers refer to the Specimens)



*Sketch* 5. Plan of the locality.

*a.* Present bank of the river, 40 to 60 feet above the lowest level of the dry season.

*b.* former bank, 100 to 140 feet above ditto.

*c.* Bank, in, or near which the slabs are found.

## 2.—*Notes on Specimens of Kankar and Rock taken from the Bed of the Jamna, between Agra and Allahabad.* (*Plate XXIV.*)

*Fig.* 6—represents a section of the river bank at *Sinjaity*, above *Etáwa*, with the kankar jutting under water.

No. 1. Loose kankar gravel, cemented with clay and lime.
2. Ditto, with kankar cement: micaceous sand.
3. Botryoidal kankar.
4. Resembles 2, but more solid.

*Fig.* 7.—*Kaláysar*, at the junction of the *Sinde*, 20th April.

No. 5. Hard sandy kankar.
6. Stalactitic kankar, rich in lime.

*Fig.* 8—is a plan of the surface of stratum A in the last sketch, which much resembles the filling up of the natural cracks, formed on the drying of a clayey soil, with a carbonaceous and sandy infiltration.

*Fig.* 9—shews the general elevation of the specimens from *Kaláysar*. The main bank immediately above rises to the height of about 70 feet, and at a furlong further back, to a total height of 130 feet; above the kankar the bank is of fine clay.

No. 7. A concretion of rolled fragments of kankar.

*Fig.* 10—is a section taken at *Kanjosa*, at the junction of the *Sinde*. Here the nodular kankar lies in inclined strata in a hard clay, upon the horizontal surface of which rests a flat plate of kankar, (similar to that extracted from the bed of the Jamna ?)

*Fig.* 11.—*Himatpúr*, 20th April. A mass of nodules in close contact, but disposed in strata nearly horizontal; some at 12 feet above the level of the water, some at less. The kankar which has acted as a cement to the mass is seen in veins.

No. 8. Hard ramified kankar.
9. Smaller, of various forms.

At *Burlót*, below the junction of the *Chambal*, 20th April.

No. 10. White kankar in sandy clay; of this there are extensive shoals, which offered obstructions to the navigation.

No. 11. Rock kankar, a granular concrete, with marks of shells? Stratum, two feet thick, sixty feet above the lowest level of the river: total height of the precipitous bank about 100 feet.

*Fig.* 12.—At *Naní*, between *Calpí* and *Hamírpúr*, the measurement and nature of the strata are shewn in the sketch.

No. 12. Is a firm clay.
13. A sandy marl, effervesces with acids.

14. Rock kankar, a calcareous sandstone, containing angular fragments of silex, felspar, and yellow clay. A few strata, about one foot thick each, with strata of the usual description between, form together masses of 12 feet thick rising to 17 feet above the surface of the water.

*Fig.* 13.—Section of the clay bank above *Hamírpur* and below *Secrorí Ghát.* The kankar (15) here appears in vertical seams in the scarped front of the bank, which is itself of a firm clay.

No. 16. Sandy clay, with perforations—and an imbedded *unio* shell, open.

17. Ramified kankar from the bank at the level of the water, *Hamírpúr.*

*Fig.* 14.—Section of part of the bank at *Arroel,* below *Hamírpúr.*

No. 18. Kankar conglomerate (large rolled fragments, reunited with kankar cement).

19. Plate kankar, of botryoidal form—micaceous sand adhering: from *Takouri* near *Chiladára Ghát,* it appears combined in large rocks and reefs.

*Note.*—To this part of the *Jamna* the clay and kankar formation prevails. Below, fresh descriptions of rock supersede the kankar, except in the specimens distinguished as such.

20. Red vitrified clay, or *khangar,* of variegated color, from Marka. The mass is about 200 feet in dimensions, rising 20 feet above the level of the water.

21. Ditto, partially heated, found in detached lumps near the base of ditto.

*Figs.* 15, 16, 17.—At *Agrye,* 1st May, above *Mhow.* Veins of kankar (No. 22, clayey kankar), here run in veins through red clay, containing nodules of kankar : from the unequal wear of such materials by atmospheric influence, the veins are sometimes seen to protrude like dykes above the clay, as represented in Fig. 15, to the height of half a foot or more : the superficial appearance is reticulated, as shewn in Fig. 17.

No. 23. Plate kankar from *Kankota*;—of this kind extensive beds and reefs occur, it is much the same as that at *Pachkouri.*

The other specimens forwarded with the kankar series, are as follows :

No. 24. A calcedonic conglomerate of fused lithomarge, forming the substance of a rocky island above the *Taboda* hill, taken from the mass 25 to 40 feet above the water-level.

Specimens from *Mhow,* 40 miles above *Allahabad.*

No. 25. Sandstone from the rock about the centre of the river, at six feet above the level of the water.

26. Lithomarge, in masses, 10 feet above the water.

27. Sandstone flag, from the *Bundelkhand* bank of the river.

28. Red clay and gravel (ferruginous kankar), running in veins 30 to 40 feet in length, 3 or 4 inches thick, taken from the same spot as No. 27.

29. Friable white sandstone, from about the centre of the river, near the lower part of the pass, forming large reefs and masses, 3 or 4 feet above the water-level.

30. Sandstone, fine grained, from a large mass about the centre of the river, in the higher part of the pass, taken from 3 or 4 feet above the level of the water.

Specimens from the great reef at *Bamiári*.

31. Hard sandstone, 6 to 10 feet above the level.

32. Kankar, in very small quantities, found near the above.

Unless specified otherwise, it should be understood, that by the "level of the water," in the preceding notes, is meant every where the lowest annual level of the river.

Small springs, flowing in free through scanty streams, run from under many of the ledges of kankar on the banks of the river. They are rarely met with except in these situations, and in the possibility of their being still impregnated with the calcareous matter which seems to have been the principal agent in the formation of the kankar, some of the water has been brought off in bottles,—a rude attempt made here to discover the presence of lime was not successful in detecting it*.

3.—*List of Fossil bones found in various situations in the prosecution of the Jumna works at Karimkhán*, 1833.

The numbers refer to the specimens presented to the Society, and to the figures in plate XXV.

1. A tooth supposed to have belonged to an elephant, 14 or 15 years old.
2. The bony or inner part of an elephant's tusk.
3. The extreme point of an elephant's shoulder-blade; the remaining part of the bone weighed about 1½ maunds.
4. A portion of an elephant's shin-bone.
5. Portions of the back-bone of a camel, (?) or one of the vertebræ of the lower part of the neck.
6. Knuckle bone of the knee-joint of ditto.
7. That part of the shin-bone nearest the fetlock joint of ditto, or end of the shank-bone next the knee.
8. Portion of a rib of ditto.

* Both of these waters were found to be nearly pure, their specific gravity being sensibly the same as that of distilled water. On applying the proper tests, the only salt discovered in the water from *Nani* was carbonate of lime; that from *Arroel* contained the same, with a very slight admixture of muriate of soda. The slight solution of carbonate of lime may have been rather derived from the kankar, than have aided in producing it.—Ed.

9. Portions of human bones, (?) the two black ones being the head of the thigh-bone and head of the arm-bone.

10. Two pieces supposed to have been parts of alligators.

11. Portions of bones belonging to the skeletons of horses, buffaloes, &c.

12. The upper part of the leg-bone nearest the shoulder of a young elephant, or the lower part of the thigh-bone of the same animal.

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1 and 2 were taken out of a mixture of sand and kankar, partially exposed to the atmosphere.

3, 4, 8, 9, 10 and 11, were all procured on sloping the banks of a channel, the sides of which are from 1 to 5 feet above the lowest level of the river (the bank being 50 feet high.) They were dug from depths of from 6 to 18 inches in the firm shoal, which is composed of substances, kankar stone, gravel, rounded bricks (vitrified clay ?) more or less rolled and cemented by mud and clay.

5. Were dug out of a cleft in hard yellow clay about 9 inches deep, filled with black mud, about 3 feet from the surface of the water.

6. Were found in the bed of the river about 18 inches deep, and 4 feet from the surface of the water, during the excavation of a bund.

12—was found on the left shore of the *Jamna*, at *Choura*, above *Calpí*, partially imbedded in a clay and kanker bank: all the rest were dug up at *Karimkhán*.

Of the fossil bones those found in the shoals of kankar were the least perfect, the petrifaction being less complete, or the fossil in inferior preservation. In the stiff clay, which composes a considerable portion of the bed of the river here, the fossils were in better order. This difference may be accounted for on various suppositions. The fossils, after being washed from the spots where they became such, might have been better preserved in the stiff clay than in the loose shoals; or the change into the fossil state may have taken place in the immediate neighbourhood of the clay, and those found in the loose shoals have been carried by the water from the original place of formation, having suffered injury in their progress from their first to the new situation in which they are found.

It is difficult to assign to these remains the dates of their passing into the fossil state. The greater number have been found in an extensive shoal, of partially rolled kankar, cemented by mud, and which from known changes in the river might be of very recent accumulation. A large proportion of the fossils seem to have had a former situation in the hard clay of the bed of the river, however carried thence to the kankar shoal. But whether they become fossils in the clay, or whether, after becoming so in other spots, they were swept on, till lodged in the clefts of the clay, still remains a point to be ascertained.

There is a probability in the former supposition, from the fossils found in clay being coloured throughout with its yellow tinge, whilst those dug up from gravel or kankar are of the greyish hue of these latter substances. If then the fossils are of the dates of the masses in which they were discovered, their age must be considerable, for the clay spoken of lies at great depth in the plain of the *Doab,* and must be a very early deposit.

In regard to fossils—will substances, after having completed their change to that state in some other spot, acquire throughout their internal structure the color of clays, in the clefts of which, after travelling from a distance, they may have found a fresh resting place? If they will, the difference of color in the fossils leads to no evident conclusion on the preceding surmises. One curious particular seems established after repeated inquiries. The fossils marked 5 were taken out of clefts in clay which lay below a thick stratum of rock kankar. Still it is far from certain that the rock kankar was so entire, so free from fissures, as to permit of no other explanation than that of the fossils having been deposited or changed in the clay, before the formation of the kankar which rested in it. That clay is itself of great age, it is at the bottom of the river, 40 feet from the extreme height of the rise of the river in the rains, and from 100 to 150 below the plain of the *Doab* and *Bundelkhand.*"

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To these guarded remarks of Captain E. Smith, every attention is due, and he deserves our best thanks for so impartially laying the circumstances of the *Jamna* fossils before us. It would seem to be pretty well established from his local observations, that many if not all of the fossils were first deposited in the clay stratum from 100 to 150 feet below the plain of the *Doáb,* and under the general line of the kankar formation; that upon the excavation of the present bed of the *Jamna,* many have been washed out of their original seats and removed to clefts in the ledges of rock in the bed of the river, and have been there mixed up with a fresher muddy deposit, and in some cases impregnated with a tint therefrom. That they belong to the former period, and that the kankar attached to them is also much more ancient than the present sands of the river, is rendered sufficiently evident in some of the specimens by the large angular quartz and felspar gravel, cemented on to many of the bones. Some angular pebbles of quartz are here and there perceived also in the concretions of rolled kankar; and it is a curious fact, that the size and description of the granitic gravel adhering to the bones, exactly resemble the characters of those attached to the *Jabalpur* fossils.

With regard to the human bones (No. 9), much doubt may fairly be entertained, on account both of the imperfect preservation of the fragments and the rarity of their occurrence in a fossil state: indeed, it is well known to be a much contested point whether the bones of man, or those of the monkey tribe, have ever been so discovered; although the careful examination of the human remains lately found in the caves of the south of France seem to have set the point at rest with most of the French geologists.

As the Annales de Chimie*, in which M. Tournal sets forth his opinions, is rarely to be met with in India, and as the animal remains inhumed in the mud and gravel of caves may prove hereafter to be contemporaneous, geologically speaking, with our newly-discovered deposits under the clays of the *Doáb*, we shall make no apology for concluding our present notice with a brief sketch of M. Tournal's view on this interesting subject.

*Occurrence of the Bones of Man in the Fossil State.*

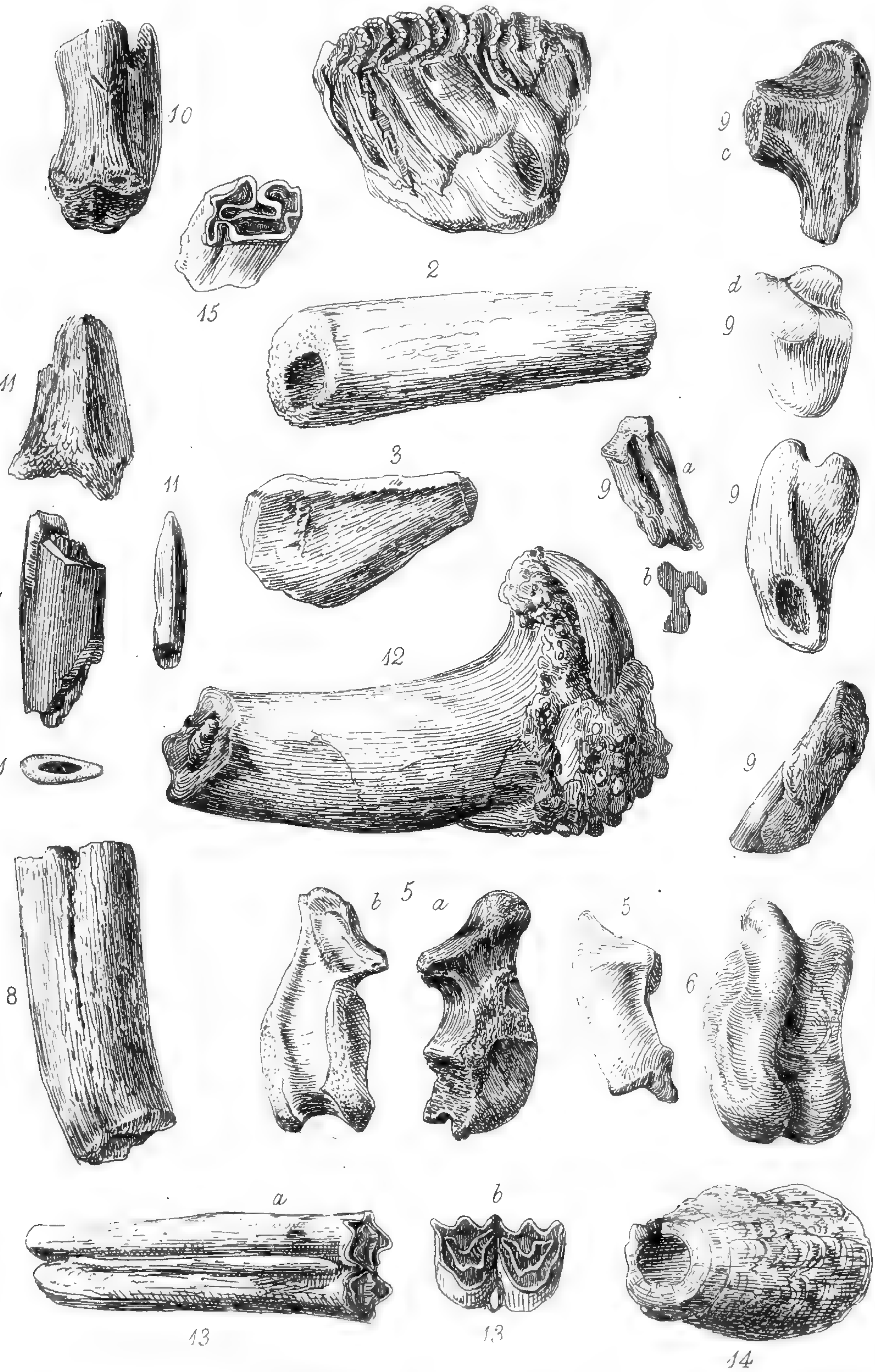
The phenomena of caves is much more complicated than was at first supposed, when the simple theory of a diluvial wave washing into them the debris of animals on the instant of their sudden destruction was proposed as sufficient to account for the quantity of bones found imbedded in the mud, gravel, and stalagmite of these truly valuable geological depositories.

Of the vast number of caves lately brought to light on the continent of Europe, some have been found to contain no fossils; others merely gravel and mud;—some, ancient bones and coprolite; and others only a prodigious quantity of the recent dung of bats and birds of prey. No general law pertains to them. They occur at all heights;—in calcareous rocks of every different age, and at various elevations above the present contiguous valleys. Such as are found in inaccessible situations, and at a distance from running water, are generally empty; those of which the apertures have been but recently disclosed by gradual wear of the rock in front, contain only modern deposits; the nature of the organic remains varying according to the locality and the antiquity of the aperture. In some cases we meet exclusively with the bones of a species of large bear *(ursus spelæus)*, the skeletons of which are still in connection, and appear to have been gradually imbed-

* Annales de Chimie, Fevrier, 1833.

Fossil bones from the bed of the Jumna River, collected by Captn. E. Smith, Eng.

No. 1.




Nos. 13. 14. & 15. from Lieut Burts Collection.

ded and thus perfectly preserved. In others, like Kirkdale, the mass consists of a multitude of bones, half gnawed and rounded, among which is remarked a quantity of hyænas' dung (coprolite); in others a narrow crevice is filled with skeletons of the smaller carnivorous animals and birds. The formation in all these cases is natural and evident: the habits of bears and hyænas of the present day accord exactly with what we see to have been their practice in ages past: the caves were the residence of these animals for generations, and were by no means filled by any brisk transient or universal wave of transport: and there is no ground deducible from them for the separation of organic remains into the two classes of *ante* and *post*-diluvian.

The soil of these caverns generally has a strictly local origin, and may be identified with the debris of the neighbouring mountains. In most cases it can be proved to have been gradually introduced from some opening above, and not from apertures fronting the present valleys, which have in most cases been laid bare by the subsequent denudation of the channel of the present rivers, when the level of the ocean subsided: the strata of soil can be divided into the finest laminæ, and very often thick strata of stalagmite separate one bed of soil, and its contents, from the next.

Having proved that the fossil caves vary in their contents from local circumstances, and that they have been filled in very long periods, M. Tournal comes to the important question, whether the cave deposit ever contains human bones, or pottery and works of human art; and, if so, whether these objects appear to be coeval with the other matter of the caves; in fact, whether man was or was not contemporaneous with animals now considered to be extinct, and, as it were, belonging to a former creation.

Human remains had been long since observed both in what was called diluvial clay, and in the soil of caves; but their presence was deemed accidental, and it became a dogma of the science that man existed not in a fossil state. The recent discovery however of the caverns of Aude, Herault, and Gard exposed a vast magazine of human bones and antique pottery inclosed in the self-same matrix with the hyæna, lion, tiger, stag, and numerous other animals, *all of extinct species*. Attention was thus once more awakened to the subject, and MM. De Serres, Christol, and Tournal, after an attentive and conscientious examination, have come to the conclusion that all these objects, are of the same date; whence it results that man was the companion of animals now considered extinct and fossil. The grounds of their opinion are;—

the equal change which the bones have undergone: their mode of deposit: the variety of species in some of the animals, which denotes domesticity; and the occurrence of extinct species bearing the marks of cutting instruments. The problem being thus resolved, it follows that man must also be included among the fossil species, or rather that the sudden transition from one condition of being to another must be disallowed, and that the same gradual alteration of species, already so fully developed by M. DESHAYES in his comparison of the fossil shells of the different periods of the tertiary formations, must be extended to animals, and perchance to man himself: that, in fact, the barrier of fossil and non-fossil must henceforth be a distinction of convenience only, to separate such remains as may be found buried in the regular geological strata, from those of more modern or accidental inhumation.

M. DESNOYERS however suggests that these bones may be comparatively modern, and that they may belong to the primitive Gauls, who lived in caverns. This opinion accords well enough with the circumstances of the cavern at *Miallet*, in which M. TEISSIER found little figures, fragments of jars, bracelets, &c. but it will not at all apply to the other localities described, and in which the mixture of bones is so decided.

Great light is thrown by these discoveries on the before ill-explained fact of the occurrence of human bones in the breccias of Cagliari, Nice, Gibraltar, and Tripoli, which contain marine shells, and seem to prove that the level of the sea was once 150 feet higher than at present: the caves generally betoken an equal height of the running streams which are supposed to have gradually silted up the caverns.

The shell deposit of Cape St. Hospice, near Nice, also contains broken pottery, and the same has been observed in the bone-breccias of Dalmatia and Syria, which contain human bones, as does the ossiferous sand of Bades near Vienna.

M. BOUE' rightly observes that such facts are of too frequent occurrence to allow of explanation on the ground of any accidental introduction during the period to which history extends. They all testify a lowering of the ocean level with respect to the land, caused by the upheavement of the latter, and thus render it evident, that these changes have been in action subsequent to the existence of man on the globe.

M. TOURNAL and other French naturalists, further suppose that several races of men have successively had possession of our continents. The form of the skulls found at Vienna is stated to approach to the African or Negro type. Those discovered in the fluviatile marl of the valley of the Rhine and Danube exhibit a close resemblance to the heads of the Karaibs or those of the ancient inhabitants of Peru and Chili. It is of course in vain to seek in the most ancient histories of these countries for any tradition of the violent commotions which the crust of the earth has endured (as is now proved), since man became its tenant. Geology alone can seek to unravel the general facts in an uncertain thread of events, through the gradual development of the records carefully treasured in caves and strata, and written in actual symbols of life of less equivocal interpretation than Egyptian hieroglyphics. But the subject is yet new, the facts limited, and we must be cautioned against coming to any conclusions without the most mature and impartial examination. It is to this philosophic caution perhaps that we must attribute the silence of Mr. CONYBEARE on so interesting a topic, in his report on geology to the British Association in 1832. After alluding to Professor BUCKLAND'S acute observatioms on the numerous bone caverns of England and Germany, "which have thrown so much light on the particulars of the history of so many long-extinct races of animals, and proved beyond a doubt that they were originally the inhabitants of the districts where their remains are now found;" he briefly adds, "but still on many questions connected with this curious and interesting subject, especially the relative age of the human bones occasionally found in the same cavern (as at Bize in the South of France), we are bound to compare the opposite views of DE SERRES, CHRISTOL, and TOURNAL, with those of BUCKLAND, with whom however DESNOYERS appears entirely to agree."

The last edition of DELA BECHE'S manual also barely alludes to the fact of human bones having been lately found in the same mass with the remains of the extinct rhinoceros and other animals usually discovered in caverns.

We have dwelt at some length on this novel subject, in hopes of drawing the attention of our Indian geologists more zealously to prosecute their investigation of the new field of organic remains now opened to their labours in the clay of the *Doáb* and the banks of the *Jamna*. Should it be proved that the bones of man are there really imbedded, and that the animals found with him are (like the elephant of *Jabalpur*) of the existing Asiatic species, it will form a strong and very important link of connection between the state of things at two distant epochs of our globe, now distinguished as the recent and the fossil periods.

In digging wells in the *Doáb*, or in any part of the upper Gangetic plain, the search for fossil bones at considerable depths should not be neglected, even under the strata of kankar, which occur almost every where in the yellow clay. We might not despair even of finding bones at the lowermost depth to which we have bored in Calcutta, for the yellow clay under the blue alluvial beds contains kankar, and is of the same apparent age as that of the *Doáb*.

J. P.

VI.—*Further particulars of the Earthquake in Nepal. By* A. Campbell, *Esq. Assistant Surgeon attached to the Residency.*

In pursuance of the attempt made before to note the destructive effects of the earthquake of the 26th August last, throughout the valley of Nepal, and its immediate neighbourhood, and with the hope of shewing, as correctly as my information will permit, the probable seat or central point of the commotion, I beg to offer the following memoranda of other places at which the shock was experienced, as well as its comparative degree of intensity at each.

The means of estimating the violence of this phenomenon are of course most defective, if not wholly inadequate to the purpose; but in absence of better data, the ascertained amount of damage done to the frail and perishable works of man, may be received as an index of its intensity at one place, compared with that of another, and in conformity to this mode, it would appear, that the most extreme violence of the shock, as far as its occurrence is as yet known, was expended within a tract of country extending from this side of the great Himálayan range on the north, to the course of the Ganges on the south, and from the *Arún* river (in the Nepal hills) on the east, to the western branches of the *Trisúl Ganga* on the west, comprising a space of about 200 miles from north to south, and 150 from east to west. In this space, the valley of Nepal, though not geographically the centre point, is most assuredly the portion that has suffered the greatest violence of the calamity; and, unless the inexplicable producing causes have been expended in the frequent and severe shocks that have to this day continued to recur, we may from our experience of the progress of earthquakes in other parts of the world, with reason, as we ought with resignation, look forward to further and more violent exhibitions of the same terrible nature.

In the notice of the earthquake by the Secretary of the Asiatic Society, in his Journal for August, he expressed a belief, that the greatest intensity of the shock would be found to have occured beyond the Himálaya, in the direction of *Lassa;* and judging by the direction from which the shock was felt to have proceeded, and its intensity in the valley of Nepal, such was the probability, though other has turned out to be the fact, and that upon good authority.

The recent return from Pekin of an Embassy from Nepal, to the court of the Celestial Emperor, has furnished authentic information on this subject, which otherwise might have been long wanting; and the whole tenor of it shews that the great Himálayan range itself, and the country on *this* side of it, was alone the theatre of the earthquake's presence, and that it was not even in the slightest degree felt beyond a very short distance on the Tibetan side of those huge mountains. The Embassy was at *Lassa,* on the 26th of August, when and where the shock was not experienced. At *Digarchi,* in the following month, it first received accounts of its occurrence from Nepal; to the inhabitants of that place the circumstance was known only from reports brought from this side of the mountains; along the road from *Digarchi,* the answer to all inquiries was the same, "No earthquake on the 26th of August," and not until its arrival at *Tingrí* was it found that the shock had been felt. *Tingrí* is a small Chinese post, immediately beyond the great Himálaya, and the first stage on the table land (as it is called) of Tibet, going from hence to *Lassa,* (by the *Kúti* or eastern pass from the valley of Nepal.) From *Tingrí* to *Kírung,* a distance of 8 or 10 marches, the route is nearly due west, running along; and through the northern side of the Himalaya, and throughout this tract, though but thinly inhabited, authentic reports of the occurrence of the shock were received. By *Kírung* (the eastern pass from the valley into Bhote), the Mission penetrated the great range, and at each stage (four in number through the pass), intelligence of the occurrence was communicated by the few individuals who inhabit that wild and sterile region. But such information was not required, as its effects were sufficiently manifest: in the village of *Kírung* itself, supposed to contain 400 houses, 60 were fairly demolished, and many more seriously injured: two men had been killed under the ruins of their houses, and about a dozen wounded. From the exit of the pass to *Kathmandú* there are no towns along the route, and scarcely any villages; but at many places, insulated houses of the mountaineers had been thrown down, and the precipitous banks of hills and mountains had been hurled into the subjacent valleys.

This shews the extent of damage done towards the north, and enables us to fix upon the line of *Tingrí* (Lat. 28°) as the northern limit, of the earthquake's presence, and reports would shew that of *Jabalpúr* and *Calcutta* to have been the southern one. *Rangpúr** defines the east and Dehli the west.

North-east from *Kathmandú,* as far as *Dúlka* and *Kúti,* the violence of the shock would seem to have been greater than in the valley. West from *Kathmandú* it diminished at every step. At *Gorkha,* only two houses were destroyed; at *Palpa,* none; and at *Dotí,* on the borders of *Kemaon,* the shock was felt, but not by any means severely. It will

* Mr. WALTERS informs me that it was also felt at Chittagong.—ED.

strike every one as remarkable, that while here, the shock was more violent than elsewhere, its effects should not have been felt equally at as great a distance from hence to the north as to the south. Why this? is the natural question, but who can answer where all are in darkness. Other explosive forces spread equally in all directions, this did not; granting that the centre was where the violence was greatest. To the south, the country is a level, uninterrupted plain, calculated to facilitate the rapid transmission of the agitating force, while to the north are the mightiest mountains of the world; it may therefore be supposed, that the quantity of force expended in reaching to the summits of the Himálayan peaks, and in shaking like molehills the whole of the mountain region around, could not be far short in intensity of that required to agitate slightly the plains to the southward, even to the distance above recorded. In this light, it may be imagined, that the explosive force may have spread itself equally on all sides, the greater surface distance to which it reached towards the south being balanced by the immense vertical spaces it traversed in shaking from their bases to their summits the innumerable hills and mountains of the extensive region lying between the plains of Hindustan and those of Tibet.

I subjoin an accurate register of the shocks which have occurred up to this date, given me by Captain Robinson. Many of them have been severe, and throughout the whole course of these visitations, there have been two distinct varieties observed in the character of the shocks: all those at the commencement were of undulatory or swinging kind; the others wanted this swell, and were a violent up and down shaking, with little lateral, motion. The first may be called the horizontal, the latter the vertical, variety. The former alone have been destructive to property, while the latter, from the greater noise by which they are accompanied, and the more rapid oscillations of the ground, are perhaps the more terrifying.

***Register of Earthquakes experienced at Kathmandú, from 26th August to 26th November, 1833, inclusive.***

| Date. | Time. | Remarks. |
|---|---|---|
| August 26th, | One at 5h. 55m. P. M. another at 10h. 50m. P. M. 10-58 P. M. was the time the great one commenced, and its duration was three minutes. | All of the undulating kind, as well as nine others that occurred during the same night. |
| 27th, | 4-53 A. M. 5-20 A. M. 5-26 A. M. | Also undulatory. |
| 28th, | 7-15 A. M. 4-55 P. M. | Also undulatory. |
| 30th, | 4 shocks, one at 9 A. M. | |
| 31st, | 2 during the night, | Slight. |
| Sept. 1, to 11th, | 10 shocks, | Slight. |
| October 4th, | 7-30 A. M. a smart one, 1 minute's duration. | This was a severe one, and of the vertical kind; it was felt at Gorakhpúr and Allahabad. |

| *Date.* | *Time.* | *Remarks.* |
|---|---|---|
| October 18th, | 1-55, P. M. severe, and ushered in with a loud noise. | Same character as last one; was felt slightly at Allahabad, lasted here at least a minute. |
| 26th, | 10-37, A. M. slight. | |
| November 8th, | 3-35 A. M. slight. | |
| 16th, | At midnight, slight. | |
| 26th, | 11-45 P. M. severe. In all, 39 shocks have been noted: many slight ones have occurred besides. | This was of the up and down kind, lasted a minute, and occurring at the full moon, when the whole people of Nepal were praying at Pasputnath, excited a great commotion, and was the only instance where the prophecies of the Brahmins were realized, although a hundred lucky moments had for the last three months been determined on for the occurrence of violent shocks. |

## VII.—*Note on the Fossil Palms and Shells lately discovered on the Table-land of Ságar, in Central India. By* H. H. Spry, *Esq. Bengal Medical Service.*

[Read at the Meeting of the 26th December.]

Some months since, when I forwarded a specimen of the silicified palm trees, I stated that the trap hills about *Ságar,* which are at an elevation of upwards of 2000 feet above the sea, formed an amphitheatre, not however in one continuous circle, but with here and there a break. Within this circle of trap hills, I ought to have stated that a second jutted out of compact red sandstone, but of a less elevated extent, being portions of the great *Vindya* range.

I took occasion to advert to the former of these two formations, because it was at the foot of the portion that ranges along the *Jabalpúr* road: the limestone bed (travertine and crystallized calcareous spar) projects; on which, mixed with the *trap* debris, the *silicified* fossil trees are found. I lay stress on the word silicified, for it seems singular that silex should be the fossilizing mineral of remains found on a calcareous bed. It would seem to indicate that the bed these remains now repose on could not have been the place of their growth*, but that they must have been projected from a distance; and yet the distance could not have been great, for although the splintered condition of the trunks would indicate that a powerful force had been applied, the attachment still of all the tender tendrils, so peculiar to the palmata species, to the thicker parts of the roots, and which, though perfectly fossilized, may

* The constant occurrence of flints in chalk is sufficient to outweigh this objection.—Ed.

be easily broken off, clearly shews how little the abrasion must have been. That however their present site is not their original one, seems now to be further confirmed by the discovery of a bed of fossil shells (univalves reversed), only distant about half a mile, and apparently in a continuation of the same limestone bed as that on which these palm-trees lie*. In the one case, however, the calcareous formation forms the surface soil, whereas in the latter it is covered by 17 feet of hard and soft basalt.

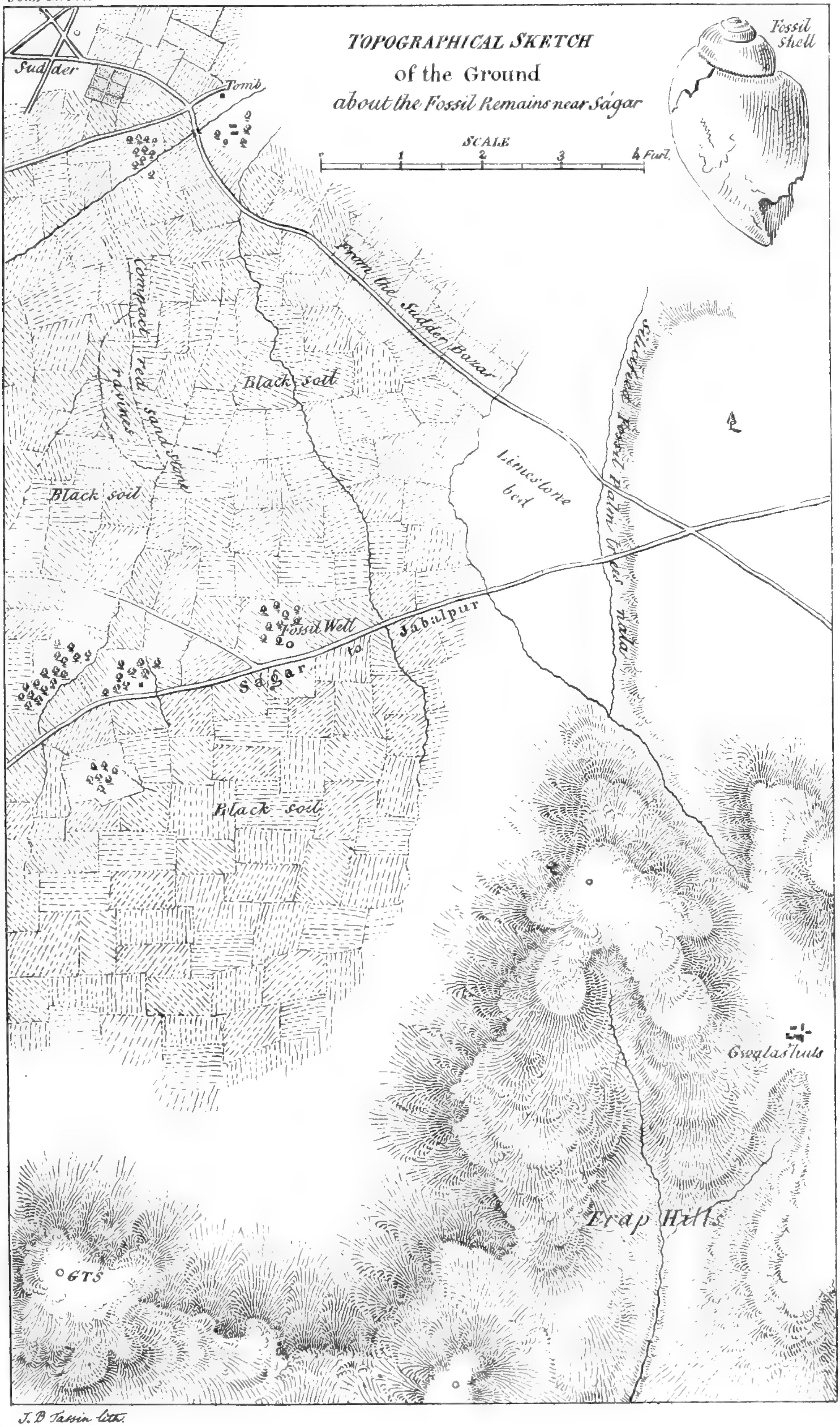
The discovery of these shells was made, as discoveries of the kind usually are, by accident, at the foot of the trap hills beside which the Jabalpúr road runs; a well had been dug some 14 years ago, and with the stones turned out of it a small hut had been erected. It was in a lump of the out-turned limestone deposit (travertine), a large shell was observed, and inquiry discovered the original locale of it to have been the centre of the well; the sides of the well had been built up with red sandstone, and it was necessary to sink a shaft beside it to get at an accurate knowledge of the site. I caused specimens of the different strata to be preserved, at the same time noting their depth respectively: a sample of each stratum, as well as specimens of the fossils, I have had the pleasure of forwarding for the museum of the Society. I am unable satisfactorily to determine whether the shells are of marine or terrestrial origin. The opinion here is that they are marine: a striking peculiarity in them is that they are all reversed, and some are much more flattened than others.

The surface soil, (No. 1) as well as Nos. 2, 3 and 4, are well marked, and the transition from one to the other is as abrupt and sudden as the specimens furnished. No. 5 is not so well marked. I have called it wacke. It pervades as a sub-soil a large portion of the trap soil about *Ságar*. A coarse analysis which I made of some from a well about a mile from the fossil well, gave me

Specific Gravity, 3,600.

| | | |
|---|---|---|
| 200 parts, | Loss by drying,........ | 34 |
| | Magnesia,............. | 18 |
| | Alumina,.............. | 14 |
| | Peroxyde iron,.......... | 30 |
| | Siliceous sand,.......... | 100 |
| | Loss,................. | 4 |
| | | 200 |

* The annexed topographical sketch (Plate XXVI), which I am enabled to furnish through the kindness of Capt. MACDONALD, of the trigonometrical survey, will convey a better idea of the locale of the two sites than any written description.




J. B. Tassin lith.

When first dug out it is friable and has a very gritty feel, falling abroad on being thrown into water like lime when it is slaking. In the sample I have sent I find several minute nodules of carbonate of lime, which will of course alter the results as given above. No. 7 is a coarse silicious grit, and No. 8 is basalt again. Beyond which I did not consider it necessary to extend my search.

I do not venture to offer any hypothesis on the discovery of the above interesting facts, but content myself by bringing to the notice of the members of the Asiatic Society of Calcutta the singular circumstance of shells in a high state of preservation lodged in a calcareous bed, being found in the midst of volcanic matter. I hope some day to be able to ascertain the limits of the fossil beds.

The following is a section of the shaft :

1. Surface soil, black, 3 feet.
2. Soft basalt, 2½ do.
3. Hard basalt, 7 do.
4. Soft basalt, 1½ do.
5. Wacke with nodules of limestone, 3 do.
6. Travertine with imbedded shells, 1½ do.
7. Coarse silicious grit, 2 do.
8. Hard basalt.

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## VIII.—*Meteorological Register at Barelly, in* 1831. *By* H. S. Boulderson, *Esq.*

| *May.* | | *Bar.* 32° | *T. A.* | *M. B.* | *May.* | | *Bar.* 32° | *T. A.* | *M. B.* |
|---|---|---|---|---|---|---|---|---|---|
| 8 | 3 P. M. | 28.914 | 102 | .... | 17 | Noon ..... | 28.930 | 100 | 76 |
| 11 | 5 P. M. | .739 | 106 | 73 | | Sunset..... | .815 | 100 | 75 |
| 12 | 7½ A. M. | .836 | 81 | 66 | | 10 P. M. | .850 | 94 | 73 |
| | 3 50 P. M. | .803 | 105 | 74 | 18 | 6 A. M. | .833 | 78 | 63 |
| 13 | Noon .. .. | .908 | 98 | 75 | | 9 A. M. | .847 | 91 | 73 |
| | 2 40 P. M. | .857 | 99 | 75 | | 2 P. M. | .791 | 103 | 72 |
| 14 | 6 A. M. | .844 | 83 | 70 | | 4 20 P. M. | .756 | 104 | 74 |
| | 9½ A. M. | .889 | 92 | 74 | 19 | 7 A. M. | .814 | 92 | 71 |
| | 5½ P. M. | .820 | 102 | 75 | | 9½ A. M. | .848 | 98 | 76 |
| | 10 P. M. | .851 | 92 | 75 | | Noon .. .. | .814 | 102 | 77 |
| 15 | 6½ A. M. | .893 | 84 | 69½ | | 3 P. M. | .752 | 104 | 76 |
| | 9 A. M. | .935 | 91 | 73 | 20 | 9½ A. M. | .894 | 95 | 75 |
| | Noon ..... | .921 | 98 | 75 | | 3 P. M. | .834 | 103 | 75 |
| | 3½ P. M. | .858 | 103½ | 76 | | Sunset .... | .815 | 101 | 75 |
| | 5½ P. M. | .830 | 102 | 76 | 21 | 6 A. M. | .846 | 81 | 65 |
| 16 | 7½ A. M. | .972 | 89 | 73 | | 9 A. M. | .880 | 93 | 73 |
| | 10 A. M. | .965 | 96 | 77 | | 4 P. M. | .823 | 104 | 75 |
| | Noon ..... | .965 | 100 | 77 | | Sunset .... | .838 | 100 | 74½ |
| | 4 P. M. | .905 | 102 | 77 | | 12 P. M. | .853 | 90 | 68 |
| | Sunset .... | .886 | 100 | 76 | 22 | 7 A. M. | .878 | 88 | 70 |
| 17 | 6½ A. M. | .914 | 86 | 72 | | 9 A. M, . | .921 | 92 | 73 |

| *May.* | | *Bar.* 32° | *T. A.* | *M. B.* |
|---|---|---|---|---|
| 22 | Noon .. .. | 28.903 | 99 | 74 |
| | 4 P. M. . | .821 | 103 | 76 |
| 23 | 6 A. M. . | .913 | 82 | 68 |
| | 9 A. M. . | .961 | 91 | 72 |
| | 3 P. M. . | .886 | 102 | 77 |
| | 6 P. M. . | .851 | 100 | 76 |
| | 11 P. M. . | .882 | 91 | 74 |
| 24 | 7 A. M. . | .924 | 84 | 72 |
| | 9 A. M. . | .968 | 93 | 75 |
| | 4 P. M. . | .876 | 102 | 76½ |
| 25 | 7 A. M. . | .960 | 84 | 73 |
| | Noon .. .. | .978 | 102 | 75 |
| | Sunset .... | .880 | 100 | 75 |
| 26 | 6 A. M. . | .961 | 84 | 74 |
| | Noon .. .. | .996 | 101 | 78 |
| | Sunset .... | .894 | 100 | 75 |
| 27 | 7 A. M. . | .971 | 88 | 74 |
| | 9 A. M. . | .976 | 94 | 75½ |
| | Noon .. .. | .940 | 102 | 78 |
| | 3 P. M. . | .898 | 104 | 78 |
| | 5 P. M. . | .858 | 104 | 77 |
| | 10 P. M. . | .860 | 97 | 76 |
| 28 | 6 A. M. . | .900 | 85 | 73 |
| | 9 A. M. . | .928 | 94 | 77 |
| | Noon .. .. | .898 | 102 | 79 |
| | 11 P. M. . | .852 | 92 | 71 |
| 29 | 7 A. M. . | .855 | 88 | 70 |
| | 9 A. M. . | .888 | 94 | 73 |
| | 7 P. M. . | .794 | 100 | 74 |
| | 10 P. M. . | .828 | 95 | 71 |
| 30 | 7 A. M. . | .847 | 88 | 71 |
| | 2 P. M. . | .806 | 102 | 77½ |
| | Sunset .... | .755 | 101 | 76 |
| 31 | 7 A. M. . | .844 | 90 | 78 |
| | 10½ A. M. . | .845 | 97 | 79½ |
| | Noon .. .. | .745 | 101 | 79 |
| | Sunset .... | .666 | 100 | 79 |
| | 11 P. M. . | .680 | 93½ | 78 |
| *June,* 1831. | | | | |
| 1 | 7 A. M. . | 28.736 | 89 | 76 |
| | 10 A. M. . | .851 | 94½ | 79½ |
| | Noon ..... | .742 | 98 | 80 |
| | 2 30 P. M.. | .667 | 102 | 80 |
| | 4 P. M. . | .634 | 103 | 79½ |
| | 6 P. M. . | .581 | 102 | 78 |
| | 8 P. M. . | .597 | 98 | 78 |
| | 11 P. M. . | .615 | 96 | 78 |
| 2 | 7 A. M. . | .712 | 91 | 80 |
| | 10 A. M. . | .758 | 95 | 82 |
| | 3½ P. M. . | .660 | 101 | 82 |
| | 6 P. M. . | .612 | 101 | 81 |
| | 10½ P. M. . | .343 | 96 | 78 |
| 3 | 6 A. M. . | .769 | 88 | 79 |
| | 9 A. M. . | .808 | 92 | 80 |
| | Noon ..... | .807 | 98 | 81 |
| | 2 P. M. . | .751 | 100 | 82 |
| | 3½ P. M. . | .709 | 100 | 82 |

| *June,* 1831. | | *Bar.* 32° | *T. A.* | *M. B.* |
|---|---|---|---|---|
| 3 | 7 P. M. . | 28.652 | 98 | 81½ |
| | 10¼ P. M. . | .673 | 96 | 82 |
| 4 | 7½ A. M. . | .779 | 92 | 82 |
| | 9½ A. M. . | .797 | 94 | 82 |
| | 1 P. M. . | .777 | 100 | 84 |
| | Sunset .... | .677 | 100 | 82 |
| 5 | 8 A. M. . | .839 | 92 | 82 |
| | Sunset .... | .721 | 100 | 83 |
| | 10½ P. M. . | .725 | 97 | 82 |
| 6 | 6½ A. M. . | .823 | 90 | 80 |
| | 10 A. M. . | .841 | 94 | 82 |
| | 3½ P. M. . | .727 | 100 | 83½ |
| | Sunset .... | .557 | 99 | 82 |
| | 10½ P. M. . | .743 | 94 | 81½ |
| 7 | 7 A. M. . | .805 | 91 | 80 |
| | 9 A. M. . | .857 | 90 | 80½ |
| | 4 P. M. . | .757 | 97 | 82 |
| | Sunset .... | .773 | 91 | 82 |
| | 10 P. M. . | .835 | 87 | 78 |
| 8 | 7½ A. M. . | .899 | 87 | 79 |
| | 10 A. M. . | .904 | 93 | 80½ |
| | Sunset .... | .768 | 94 | 83 |
| | 10 P. M. . | .829 | 92 | 81 |
| 9 | 7½ A. M. . | .926 | 81 | 75 |
| | 10 A. M. . | .935 | 81½ | 76 |
| | 4 P. M. . | .865 | 90 | 80 |
| 14 | 8 A. M. . | .884 | 89 | 81 |
| | Noon ..... | .891 | 91 | 82 |
| | 1½ P. M. . | .858 | 91 | 82 |
| | 4 P. M. . | .804 | 90½ | 81 |
| | Sunset .... | .800 | 90 | 80½ |
| | 9½ P. M. . | .802 | 88 | 82 |
| 15 | 7 A. M. . | .803 | 86 | 82½ |
| | 9 A. M. . | .819 | 88½ | 82½ |
| | 3 P. M. . | .707 | 95 | 81 |
| | 10½ P. M. . | .732 | 91 | 81½ |
| 16 | 7½ A. M. . | .755 | 90 | 82 |
| | 2½ P. M. . | .692 | 98 | 82½ |
| | Sunset .... | .647 | 97 | 83 |
| | 11½ P. M. . | .725 | 92 | 82 |
| 17 | 7½ A. M. . | .766 | 91 | 81 |
| | 9 A. M. . | .768 | 93½ | 82 |
| | 2 P. M. . | .724 | 98½ | 83 |
| | 10½ P. M. . | .709 | 94 | 82 |
| 18 | 7½ A. M. . | .729 | 92 | 83 |
| | 11 A. M. . | .735 | 96 | 83 |
| | 1½ P. M. . | .705 | 100 | 82 |
| | 3 P. M. . | .675 | 101 | 82 |
| | Sunset .... | .657 | 98 | 82 |
| | 9 40 P. M. | .713 | 95 | 82 |
| 19 | 7 A. M. . | .787 | 89 | 81 |
| | 9 A. M. . | .822 | 89 | 82 |
| | Noon .. .. | .801 | 94 | 83 |
| | 3 P. M. . | .721 | 96 | 83 |
| 20 | 8 A. M. . | .805 | 87 | 82 |
| | 2 P. M. . | .777 | 90 | 82½ |
| | 12 P. M. . | .782 | 87 | 82 |

| *June*, 1831. | | *Bar.* 32° | *T. A.* | *M. B.* | *June*, 1831. | | *Bar.* 32° | *T. A.* | *M. B.* |
|---|---|---|---|---|---|---|---|---|---|
| 21 | 7½ A. M. . | 28.805 | 86½ | 81½ | 25 | 2½ P. M. . | 28.684 | 87 | 84 |
| | 10 A. M. . | .843 | 88 | 82½ | | 10½ P. M. . | .713 | 85½ | 83 |
| | Sunset .... | .734 | 88 | 81 | 26 | 7 A. M. . | .767 | 79 | 79 |
| | 11 P. M. . | .819 | 86½ | 82½ | | 9½ A. M. . | .825 | 80 | 80 |
| 22 | 6½ A. M. . | .833 | 86½ | 82 | | Noon .. .. | .825 | 82 | 80 |
| | Noon .. .. | .819 | 95 | 82½ | | Sunset .... | .813 | 82½ | 80 |
| | Sunset .... | .761 | 94 | 82½ | | 9½ P. M. . | .812 | 82 | 81 |
| | 10 P. M. . | .810 | 91 | 82 | 27 | 5½ A. M. . | .813 | 81 | 80 |
| 23 | 7½ A. M. . | .817 | 87 | 81½ | | 9½ A. M. . | .844 | 84 | 81½ |
| | 9 A. M. . | .834 | 90½ | 82 | | Sunset .... | .758 | 86 | 82 |
| | 2 P. M. . | .791 | 95 | 82½ | | 11 P. M. . | .794 | 82 | 80 |
| | 10½ P. M. . | .830 | 85½ | 81½ | 28 | 7½ A. M. . | .806 | 82 | 80½ |
| 24 | 5 40 A. M. | .765 | 84 | 80½ | | Sunset .... | .683 | 89 | 84 |
| | 9 A. M. . | .778 | 85 | 82 | 29 | 8 A. M. . | .759 | 84 | 81½ |
| | Sunset .... | .673 | 88 | 83½ | | Sunset .... | .758 | 78 | 77 |
| | 10 P. M. . | .725 | 86 | 84 | | 10 P. M. . | .794 | 82 | 81½ |
| 25 | 7½ A. M. . | .707 | 86½ | 84 | 30 | 7 A. M. . | .839 | 82 | 80 |
| | 9½ A. M. . | .727 | 87 | 84 | | 9 A. M. . | .859 | 81 | 80 |

The detached thermometer was in an open northern verandah, the moistened bulb thermometer was inside the house. The barometer was a plain tube with brass scale. The barometer tube was filled with unboiled mercury, and the air gathered and extracted by repeatedly reversing it. In the "GLEANINGS," for October, 1831, I mentioned the altitude of Barelly, gained from a few observations, as about 1080 feet. I was surprised at the result myself, but could not account for it. I think I must have made some mistake in recording the observations, or perhaps in adjusting the scale to the tube. The barometer with which the above observations were made was precisely similar to the former one, but not the same. A set* of 10 observations in May, compared with those of the corresponding times in Calcutta, gives altitude of Barelly, feet 742.29. Another set of 10 observations in the same month, feet 745.58 ; a 3rd set of 10 in the same month, feet 730.32, and a 4th set of 10 gives feet 755.4, and a set of 31 observations in June gives, feet 753.35. With the former tube and scale, a set of eight observations in May, 1830, gave the altitude of the "oaks" at Masurí, 6796 feet above Calcutta; with the same barometer in November, the same

| | | | |
|---|---|---|---|
| * 1st set of 10 | Calcutta Barometer | 29.617 | Thermometer 92.94 |
| | Bareilly | 28.891 | 98.15 |
| 2nd ditto | Calcutta | 29.560 | 92.49 |
| | Bareilly | 28.833 | 99.7 |
| 3rd ditto | Calcutta | 29.599 | 93.67 |
| | Bareilly | 28.885 | 97.5 |
| 4th ditto | Calcutta | 29.663 | 93.7 |
| | Bareilly | 28.924 | 98.7 |
| 5th ditto | Calcutta | 29.487 | 89.9 |
| | Bareilly | 28.746 | 92.5 |

year, 15 observations gave the altitude, feet 6777.7, and another set of 10 made it, feet 6775.1, and then the latter were taken after a long march in the hills, during which the barometer had been repeatedly refilled. I have a barometer made by Bate, on the principle of Guy Sussac's syphon barometer, with Captain Kater's improvements, (that is the description given of it,) and it *seems* in excellent order. This stands about .05 higher than a barometer of the above simple make, and filled in the same easy manner as above mentioned. (I should mention that the tubes used have all been of large bore.) But I have no means of discovering the error of either.

The following observations were made at Hardwar, near the centre of the pass, in a house about 150 feet above the bed of the Ganges :

| | | *Bar.* 32°. | *Ther.* | |
|---|---|---|---|---|
| 1833, May 24, | 7¾ A. M. | 28.216 | 84 | at 10 P. M. suddenly came a cool breeze and reduced the Ther. to 91. |
| | 9 20 A. M. | .236 | 96 | |
| | Noon .. | .224 | 100 | |
| | 2 P. M. | .182 | 106 | |
| | 4 P. M. | .103 | 104 | |
| | Sunset .. | .107 | 99 | |
| | 9½ P. M. | .119 | 98 | |
| ,, 25, | Sunrise.. | .153 | 75 | |
| | 7 A. M. | .220 | 83 | |
| | 9 A. M. | .227 | 94 | |
| | Noon .. | .219 | 102 | |
| | 2 P. M. | .187 | 106 | |

The height deduced from comparison with corresponding altitudes in Calcutta is, from those in the Journal*, 1214 feet above Calcutta, and from those at the Surveyor General's Office, 1276 do.

The latter are more numerous. The mean of these would be about 1245 feet, and if the estimated altitude above the river be deducted, it would leave the height of the Ganges at Hardwar above Calcutta about 1095 feet. The barometer used was, as before, a plain tube, freshly filled with mercury. Though not tried, I suppose the depression of the moist bulb thermometer must have been near 3 0.

In elucidation of the remarks on filling barometers when the air is damp, (vide Journal of the As. Soc. ii. 260.) I may record the following experiments made by myself :

On the 12th July last, when the depression of the moist bulb thermometer was 9½°, I filled a tube which stood exactly the same as one filled on the 3rd June, when the air was very dry ; in both these tubes

* My barometer stands on an average .044 lower than the Surveyor General's, which will make an addition of 50 feet necessary to the altitude calculated.—ED.

the mercury stood about inch .05 lower than that in the English barometer above mentioned.

On the 1st August, I emptied the tube which had been filled on the 3rd June; and refilled it: the results of this and a few more experiments I give below:

| 1833. | | Thermometers. | | | | |
|---|---|---|---|---|---|---|
| *1st Aug.* | *Eng. Bar.* | *Altd.* | *Detd.* | *M. B.* | *Plain tube.* | |
| 4 P. M. | 28.684 | 86½ | 87 | 83½ | 28.594 | tube fresh filled. |
| 5 P. M. | .666 | do. | do. | do. | .412 | tube again filled after remaining empty an hour. |
| | | | | | .374 | tube again filled. |
| | | | | | .564 | tube wiped out and filled. |
| 6 P. M. | .672 | 86½ | 85 | 83½ | .552 | ditto ditto. |
| | | | | | .626 | tube wiped out very carefully. |

The tube was wiped with an iron wire, round which silk was bound for about six inches, and on the last occasion, I heated the silk over a fire, and kept up a smart friction in the tube, till I felt a sensible heat from it. I should think that similar results might always be gained. The height at which the mercury stood, after this method of drying the tube, being the same as regards the English barometer as what it was when it was filled in very dry weather on the 3rd June.

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## IX.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, the 26th December,* 1833.

Captain W. N. Forbes, Engineers, in the Chair.

The Proceedings of the last Meeting were read.—G. A. Bushby, Esq. proposed at the last Meeting, was elected a Member.

A. Hamilton, M. D. Surgeon of H. M. 41st Regiment of Foot, at Moulmein, was proposed as a Member by Mr. Twining, seconded by Mr. Prinsep.

Messrs. Mackenzie, J. S. Stopford, and Mr. A. Beattie, proposed by Mr. Bagshaw, seconded by Dr. Tytler.

A letter was read from M. J. J. Marcel, Ancien Directeur de l'Imprimerie Royale, Membre de la Commission d'Egypte, &c. requesting to know the result of his application of the 14th July, 1830, and presenting copies of his Translations from the Arabic.

Mr. Marcel was elected an Honorary Member on the 4th January, 1832, but the announcement had unfortunately miscarried.

A letter from G. A. Bushby, Esq. Officiating Secretary to Government, General Department, intimating the resolution of the Right Hon'ble the Governor General in Council, that the privilege of franking accorded to the Secretary of the Asiatic Society, and extending to the Journal of the Asiatic Society, should cease from the 4th June, 1834.

After some discussion, the Secretary was empowered, in any representation he might think fit to make to the Government, on the plea of his engagement to print official documents of a scientific nature, to express the earnest desire of the Society for the continuance of a privilege which has already proved so highly beneficial to the interests and extension of Science in India.

*Library.*

The following Books were presented :

Marcel's Contes Arabes du Cheykh El-mohdy, for July, August, September, October, and November, 1832, and February, March, April, and May, 1833—*by the Author.*

Journal Asiatique, 64, 65—*by the Asiatic Society of Paris.*

Abdul Mujeed's edition of the Seyr-ul Mutakhereen, 1 vol.—*by the Editor.*

Sixth volume of the Transactions of the Medical and Physical Society—*by the Society.*

Select Speeches of John Serjeant of Pennsylvania—*by Herambanath Thakoor.*

The following works, published under the auspices of the General Committee of Public Instructions, were forwarded by the Secretary, Mr. J. C. C. Sutherland.

| | |
|---|---|
| Inaya, vol. 4. | Fatawa Alemgiri, vol. 4. |
| Kefaya, vols. 3 and 4. | Raghuvansa. |
| Aphorisms of Hippocrates. | Retnavali. |
| Sudeedee. | Wilson's Sanscrit Dictionary. |

Meteorological Registers from July to November, 1833—*by the Surveyor General.*

MS. Register of the Weather at Jorhat, Assam, for the months of August and September, 1833—*by Mr. H. Bigge.*

The following books were received from the book-sellers :

Lardner's Cabinet Cyclopedia, Herschel's Astronomy.

———————— Chronology of History.

Read an extract of a letter from Captain J. B. Jervis, Bombay Engineers.

The letter announces, that the writer is engaged in the publication of a systematic account of the weights and measures of India, to which is annexed an account of Indian Chronology, gleaned from the Vedas, Siddhantas, Purānas, &c. and brought into one view with the systems that have prevailed in all ages over the world. Whence he has deduced that all have a common origin, and that the measures of time in use among the Hindus were introduced so late as A. D. 607-8. The work is in octavo, 700 pages, and is now nearly through the press. It is to be published by subscription.

*Resolved,* that the prospectus be circulated among the members, and a list of subscribers returned to Captain Jervis.

*Antiquities.*

A large Lingam, from the Jangíra rock—presented by Lieut. T. S. Burt, Engineers.

An ancient Hindu gold coin (corresponding with No. 17 of WILSON's plates, As. Res. xvii.) was exhibited to the meeting—by the same.

Accurate drawings of the stone *lath* or column now lying in the Fort at Allahabad, and fac similes of all the inscriptions on it; and a small fragment of the stone—by the same.

A paper on the subject, by Lieut. BURT, was read.

A *talwar*, or native sword of iron, dug up from six feet under the bed of the Jamna river, was also presented by the same.

The weapon is of the modern form, and was probably lost with some wreck ; it was corroded nearly through its substance.

A manuscript table exhibiting the particulars of the twenty-four Jinas of the Budh religion, drawn up by a Pundit at Hyderabad—presented by Mr. E. C. RAVENSHAW.

*Museum.*

A piece of planking and copper sheathing, from the bottom of the Barque Adele, pierced by the horn of an unicorn fish, on her voyage from Penang to Akyab, on the 24th January, 1833—presented by Dr. TWINING, on the part of Dr. BAKER, Civil Surgeon of Noacolly.

The following extract from the log of the vessel was read :

Lat. 9° 23′ 53″ north, Long. 96° 31′ 45″ east, at 8h. 3m. P. M. of the 24th Jan., felt a sudden very severe shock aft, which made the vessel shake : could not account for it.

26th January. Found the vessel leak slightly, in consequence as supposed of the shock.

12th February. Lying at Akyab ; cleared away sand-ballast, to examine the cause of the leak. Found a rent in the ship's bottom, caused by the horn of an unicorn fish thrust through the copper sheathing, and four inches of planking ; the horn protruded seven inches on the interior, and had been snapped off close to the copper on the outside by the struggles doubtless of the animal to disengage itself.

EDWARD MARGUARD, *Commander*."

A stuffed Pangolin, or five-toed Manis—presented by Dr. BURLINI.

Two tigers' heads ; the skin of a Boa Constrictor, 14 feet long ; two stuffed birds ; two triangles, ornamented with peacock's feathers ; an Assamese hat, and other Curiosities from Assam, were presented by Dr. BURLINI, in the name of M. B. BIANCHI.

Further specimens of the Hoshungabad coal were received, from Captain J. R. OUSELEY.

Although of a better quality than the former specimen, (see page 485,) this slaty coal is still very inferior, being in fact little better than a bituminous shale ; its composition agrees nearly with that of the specimen inserted in the table of India coals, page 283 of the GLEANINGS, vol. iii.

| | | | |
|---|---|---|---|
| Specific gravity | | 1.510 | |
| Composition :— | volatile matter | 34.0 | 100.0 |
| | Carbon | 39.7 | |
| | Red earthy ash | 26.3 | |

It burns with a good flame, and leaves a slaty ash.

Specimens of the fossil bones, kankar, and rocks extracted from the bed of the Jamna—by Lieut. T. S. Burt, Engineers.

These form a valuable addition to the fossils presented in the name of Captain E. Smith at the last Meeting, and they contain the following bones not found in that series :

14. Fragments of the tusk of an elephant : one piece of very large size.
    The patella or kneepan of ditto.
13. Teeth of the camel ?
15. Tooth of a horse.

Part of the jaw of a human skull, and one other bone, were evidently recent, burning before the blowpipe, &c. whereas those in the fossil state did not contain the slightest trace of animal matter, and were of much higher specific gravity than ordinary bones : the animal matter seemed principally replaced by carbonate of lime and clay-iron. Drawings of the three teeth, marked as above, 13, 14, 15, have been inserted in the Plate of Captain Smith's collection, (Pl. xxv. of the present number.)

Lieut. Burt also presented a collection of nine species of shells found in the bed of the Jamna at *Kárim Khán.*

Captain E. Smith's notes on the kankar formation, and on the fossil bones, collected in the Jumna river, were then read.

Also a letter from Dr. H. H. Spry, on the subject of the fossil shells, presented by him at a former Meeting.

[Both of these are printed in the present number.]

A map of a route from Hoshangabad to the Fort of Makrai, in the Kalíbhít hills, was presented in the name of Lieut. R. H. Miles, with remarks on the Goand inhabitants, and on the features of the country, by the same officer.

A note on the climate of the fossil elephant, by the Rev. R. Everest, was read.

[These will be printed in an early number.]

Thanks were voted for the several contributions of the evening.

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## X.—*Miscellaneous.*

[original communications.]

### 1.—*Note on the Tailor Bird's Nest.* By Lieut. Gifford.

" I send you a tailor bird's nest along with the Journal of the Asiatic Society, in which I see a description is given of it. This is the third nest I have found ; the first one was built in a *banghen* bush ; the two last in a low thick shrub (name I know not,) but the natives make a reddish dye from the flower, which is a very light yellow colour, with pretty large leaves.

The specimen I send you was constructed of three green living leaves, with two small old (dry) ones, to fill up a space where the living ones would not meet. The leaves were sewn together with raw and spun cotton ; the bird is a light brown above, and a dirty white below, about four inches in length from tip of bill to end of tail : the *mális* call the bird *Phutki.*"

### 2.—*Note on the Inscription on the Hindu Coin. (Pl. VIII. Fig.* 15.)

At page 415 of the present volume I stated, that the characters of the inscription on the reverse of the ancient gold coins of Hindu fabrication from Kanouj, represented in fig. 15, and in several coins of Plate I. vol. xvii. Asiatic Researches, was not legible. Mr. Wilson had however suggested, that the three first letters agreed with the ancient Nagarí characters पाक, and I find on referring to Dr. Babington's *Account of the Inscriptions and Sculptures at Mahámalaipúr*, that all of the letters may be unquestionably identified with the ancient Sanskrit characters of the *Ratha* sculpture, so ably decyphered by that gentleman, and of which he has given a complete alphabet in the same volume.

The first letter is probably स rather than म or प्र although as observed by Dr. Babington, these letters are very similar in form ; the fourth letter is म and the whole word thus restored becomes clearly साकम: but the meaning is still as hidden as ever ; and if it be a proper name, none such is to be found in the catalogues of Hindu princes.—Ed.

### 3.—*Radiation in Valleys.*

Mr. W. Cracroft, in 1832, made the following observations for several mornings at sun-rise, in passing over the Kasya hills, on the radiation of heat to the sky.

| *Date. Jan.* | *Place.* | *Therm. suspended.* | *Therm. on straw.* | *Remarks.* |
|---|---|---|---|---|
| 13 | Surárím, | 38° | —— | |
| 14 | Mouflong, 9 A.M. | 30 | 27-5 | ice formed in a tumbler in the house. |
| 15 | Myrong, | 27 | 24 | |
| 16 | Nanklao, | 39 | 34 | at top of hill, brisk wind, |
| | | 31 | 30 | at bridge, in valley, 130 feet lower. |
| 17 | Ditto, | 33 | 30 | at top of hill, little wind. |
| | | 30 | 27 | at bridge below. |
| 18 | Ditto, | 42* | 30 | at top*, six inches above the ground. |
| | | 28.5 | 25.5 | at bridge, ditto |
| 19 | Ditto, | 49 | —— | on top of hill on a mat, ice within six inches of bulb, out all night!(?) |
| | | 27 | 26 | at bridge. |
| 20 | Mopea, | 43* | 39 | at top of hill*, two feet raised. |
| | | 33 | 32 | at bottom of valley, 80 feet below. |
| 21 | Ongshye, | 37.5 | 37.5 | heavy dew, same on straw. |
| 22 | Ránígaon, | 50‡ | 46† | ‡4 ft. from ground. †In a ditch 2 ft. dp. |

From the above, it may generally be remarked, that the bottom of a valley is much colder than the top of a hill at night ; although the latter must be much more open to radiation : aërial currents may be the cause of this apparent anomaly.

### 4.—*Bones in the Delta Alluvium.*

In the Report of the Asiatic Society's Committee on the boring experiment an observation occurs, that some bones were discovered in the strata of blue clay alluvium of the circular canal, at a depth of about 20 feet below the surface : on reference to some old papers in Mr. Wilson's possession, a memorandum has been met with of a similar fact observed on digging a tank at Dumdum, in the year 1813. Lieut. J. Colvin, Engineers, describes the circumstance as follows :—" The soil is throughout a fine garden mould, from two to three feet thick :— there are no nálás visible, but Dumdum is nearly surrounded by jhils and salt-water lakes. The bones form a kind of regular line with some intervals of a foot or two between them ; they lie pretty close together, their interstices filled with earth. They are so soft that all but the thickest bones break on endeavouring to separate them from the earth. I cannot say to what animal they belong, but I am very sure there are now no animals at Dumdum to which such large bones could have belonged, and I have never heard of any kind of deer near the place. The tree was found at a depth of 18 feet below the ground; it seems to be Soondry, (as is the case with most of the wood found in similar situations elsewhere.)"

We hope when a deposit of bones is again found, either at Dumdum or in any other parts of the Delta, some pains will be taken to extract them carefully, for comparison with existing species of the inhabitants of the present *Sunderban* swamps and forests; for, although, geologically speaking, they are of very modern origin, and we trace in the names of villages considerably higher up the Delta the fact of the present continent having at one period been divided into islands: such as Agardwíp, Sukhsagar, &c. Still at the present observed rate of recovery of flooded Sunderband land, it appears to require a very lengthened process to fill up from 18 to 25 feet of alluvium over the peat stratum, which was evidently the Sunderban vegetation of the time. History lends no aid in defining the sea boundary at different epochs. We must therefore seek the aid of physical research to solve the interesting question of the growth of the Delta. J. P.

### 5.—*Fall of Fish from the Sky.*

The phenomenon of fish falling from the sky in the rainy season, however incredible it may appear, has been attested by such circumstantial evidence, that no reasonable doubt can be entertained of the fact. I was as incredulous as my neighbours, until I once found a small fish, which had apparently been alive when it fell, in the brass funnel of my pluviometer at Benares, which stood on an insulated stone pillar, raised five feet above the ground in my garden. I have now before me a note of a similar phenomenon, on a considerable scale, which happened at the Nokulhatty factory, zillah Dacca Jelalpur, in 1830.

Mr. Cameron, who communicated the fact, took the precaution of having a regular deposition of the evidence of several natives who had witnessed the fall, made in Bengalee, and attested before the magistrate: the statement is well worthy of preservation in a journal of science; I therefore make no apology for introducing a translation at length. The shower of fish took place on the 19th February, 1830, in the neighbourhood of the Surbundy factory, Feridpoor. J. P.

*Deposition of the Witnesses to the Fall of Fish from Heaven, on the 9th of Phalgun, 1236, B. E. at Havelli, zillah Dacca Jelalpur.*

1. Shekh Kitabuddin, son of Shabdi, and Shekh Shumsuddin, son of Bakshu, were called, and declared in their deposition, saying, "That on Friday, in the month of Phalgun, we do not recollect the date, at 12 o'clock P. M., the sky being cloudy, there was slight rain, and a number of fish of different kinds and sizes fell from heaven; we took some of these fish and retired home. This is the account which we know."

2. Shekh Sulimuddin, son of Ibadullah, inhabitant of Bibhagdi, declared in answer, saying, "On a Friday, in the month of Phalgun, the date of which I do not recollect, at 12 o'clock evening, while I was coming from a village named *Nukolbati*, I perceived a *badali* fish, large about one cubit, fall before me from the sky; after which, I went further, and found another fish of the same size, lying upon the ground. I picked up these two fish and proceeded forward; and as soon as I arrived at home, I found, to my great surprize, that many persons had likewise collected fish, and carried along with them. This is all, and I know no more."

3. Shekh Muniruddin, son of Mydi, inhabitant of Umerbati, expressed in his deposition,—" About 12 o'clock P. M. on Friday of Phalgun, the date of which I have forgot, the clouds being gathered together, began to rain, and a little after, many fish, large and small, began to fall from the sky. I picked up some of them and carried to my house, but I did not like to taste any of them. I know no more of this account."

4. Fakirchand Chang, inhabitant of Nagdi, was called in, and declared in his deposition, "That in the month of Phalgun, the date and day of which have escaped my memory, at 12 o'clock P. M, the sky began to be cloudy, and to rain little; while I was sitting in the front part of my cottage, I observed a *mirgal*, and some other fish, *bodulis*, &c. of different size, fall from the sky. I picked up about five or six of these fish to satisfy my curiosity, but afterwards threw them away, and did not eat them at all. This is my account."

5. Shekh Chaudhari Ahmed, son of Mutiullah, inhabitant of Nagdi, relates in his deposition, "That I had been doing my work at a meadow, where I perceived at the hour of 12 o'clock, the sky gather clouds, and began to rain slightly, then a large fish touching my back by its head fell on the ground. Being surprised, I looked about, and behold a number of fish likewise fell from heaven! they were *saul, sale, guzal, mirgal,* and *bodul.* I took 10 or 11 fish in number, and I saw many other persons take many—then I returned home, I looked at heaven, and I saw like a flock of birds flying up, but these my perceptions was not clear enough. Amongst these fish, many were found rotten, without heads, and others fresh and perfect; and amongst the number which I had got, five were fresh, and the rest stinking and headless.

6. Shekh Turikullah, inhabitant of Nagdi, 12 years of age, declared in his deposition, " That in the month of Phalgun, on a certain Friday, I do not recollect the date, while I was sitting in my own house, I perceived a number of fish fall from the sky, some of them on the roof of my cottage ; one of them was large, about one cubit, and three seers in weight. I know no more."

7. Shekh Suduruddin, inhabitant of Nagdi, was called in, and declared in his deposition, saying, " On Friday, at 12 o'clock P, M. in the month of Phalgun, I do not recollect the date, when I was at work in a field, I perceived the sky darkened by clouds, began to rain a little, and a large fish fell from the sky. I was confounded at the sight, and soon entered my small cottage, which I had there, but I came out again as soon as the rain had ceased, and found every part of my hut scattered with fish, they were *boduli, mirgal,* and *nouchi,* and amounted to 25 in number.—I know no more."

8. Shekh Katbuddin, inhabitant of Nagdi, relates in his deposition, saying, " At 12 o'clock P. M. of Friday of Phalgun, the date I forget; as I was coming from the *fields*, I saw a number of fish spread on the bank of a nálá. I picked up six of them, viz. two *boduli*, two *mirgal*, and two *nouchi* , besides these, there were many other fish of numerous kinds, and they were witnessed by many persons who were there. Some of these fish were fresh, but others r otten and without heads. I know no more."

9. Sree Dipchundru Bundopadhya, son of Puncharam Bundopadhya, inhabitant of *Sobindi*, aged 45 years, declared in his deposition, " That in the month of Phalgun, I cannot recollect the date, seeing the sky commenced to gather clouds, I sat down near the door of a workman's cottage ; it was then precisely 12 o'clock, when a drizzling rain began to fall ; and at the same time, two *boduli* fish fell down from heaven. I soon got up nd marched on, and in the midst of the road,

saw several other fish fallen before me. I picked up some of these fish—but one named Banchha Ram Chung forbade me, saying, 'Do not touch these fish; you do not know what fish they are, and how they have fallen here.' Listening to him, I threw away all the fish, and went away. This is my account of the fish."

[Several other depositions of those who were not immediately eye-witnesses are omitted.]

### 6.—*Fossil h ells near Herat.*

[*Extracts of a letter from Dr. J. G. Gerard, dated Herát,* 21*st June,* 1833.]

"I have discovered the locality of a large deposit of organic exuviæ within thirty miles of this place (Herát), but have not thought it prudent to visit the spot, lest I should find myself unexpectedly in the hands of the Túrkomans.

"The fossils correspond to the species represented as Pecten,—they abound in the side of a mountain, which is evidently calcareous, but are especially found in a water-course, being rolled from their situs by that agency. Judging from the elevation of this city, which by the ebullition of water ($207\frac{1}{2}$) approaches to 2,800 feet, if the barometer stood then at 30,000* the locality of the fossils may be deduced at a height of between 3 and 4000 feet. Elevation in such objects has ceased to be interesting, since the new theory of subterranean projection has deprived it of a *miraculous* aspect. Monsieur Jaquemont when at Simla, read to me (*explained*) a letter he had received from another traveller, Mons. Elie de Beaumont in South America, I think, wherein it was mentioned, that there was a subterranean connexion betwixt the most distant mountain ranges, and that a simultaneous movement was actually going on (traceable) by which their masses were gradually elevated."

### 7.—*Cochineal.*

"I hear the Cochineal insect is here, but not appreciable, that is, it cannot be turned to account, from the inability of the people to dry it properly; this is at least one cause. I have been asked the method of its preparation, but all my knowledge extends to a faint recollection of the process adopted by the South Americans, treated of in Humboldt's published Account of New Spain. Artificial heat is there used to kill the insect. Query, may not the very mode of extinguishing life affect the properties of the colouring matter? Certain it is, that in preparations of insects, this is so much a necessary precaution that various gases, the air-pump, &c. have been resorted to for the better preservation of the hues and form of the specimens. Do we not know that there is virtue in the manner of killing animals for our daily aliment?—that the anatomist can readily discover the effects of disoxygenation (in suffocation) upon the blood and even the muscular fibre, that electricity (lightning) and the Simoom not only change the color, but produce decomposition of animal matter when their effects are fatal. I don't remember what Humboldt says on the subject, but the complaint here is, that the insect cannot be killed without a degradation of its virtues. It is found in the root of a plant that flourishes in a marsh, and many people here have exhausted their skill in endeavours to appreciate its value: most of what reaches Herát is imported from Bokhara where it is received from Russia, and I believe from Yarkhund; the latter need not surprise us if indeed the insect is an inhabitant of that country; the industry and artificial expertness of the Chinese almost lead us to the conclusion.

A species of Cochineal, or at least a substitute, is found in India, but I suspect that the mercantile article is an import from South America. As climate has such

* As the observation was made in June, when the sea barometer would stand at 29.5, the altitude may be more correctly assumed to be 2,000 feet. See page 199.—Ed.

an effect upon the productions of animal and vegetable existence, and an arid one towards the improvement of a great many of them, especially Horticultural, while the softness of the goats' fleece seems to owe its existence to that cause,—the silk-worm its superior procreative powers, and even the silk its finer structure;—the cats of those regions, Cabul especially, are well known;—when these and thousands of others are the effects of those bright and eternally blue skies, we may infer that the kírmes (Keerm, worm), or cochineal of Herát, Bokhara, and other places requires only the application of skill to render it an appreciable commodity, and even superior to the American species, except indeed that comes from the dry regions of Chili and Peru. The bazar (retail) price of Cochineal at Herát is now six Rs. per seer, country measures, or 32 St. Rs. per Indian seer. The moist opium of the place sells at 44 Rs. per seer of India, and after one year when it is pretty dry, at 70 Rs.! while a species that comes from Yezd and Kaín in Persia, in sticks like sealing-wax and as brittle as a dried reed, sells at the enormous price of 80 to 100 Rs. per Indian seer. At Bokhara I procured some at 90 Rs. methinks the Hon'ble Company's opium from Malwa at a productive cost of three Rs. per seer, would realize remunerating profit in this country, where every production of nature or art is so exorbitantly high-priced, (valuable.)"

### 8.—*Reply to the Questions of the Burmese Philosopher-Prince.*

Sir,

Having not yet seen, in your interesting Journal, any replies to the questions proposed by the Burmese Prince, in vol. ii. p. 47, I venture to send you the following for insertion, and hope they may be found satisfactory.

*Investigation of Sir Isaac Newton's statement, that some Comets have been raised, by the effect of the sun's rays, to a heat, 900 times greater than that of red hot iron.*

#### *Reply to 2nd Question.*

It is a well known fact*, that the force of heat varies, inversely, as the square of the distance of the direct cause of that heat, from the object affected by it; so that in order to determine the above point, it is only necessary to refer to the distance of the sun from the earth (95 millions of miles), where the measure of force of his rays is known, and having the distance of a Comet from the sun, to ascertain by the above rule, the degrees of heat to which the Comet has been raised, and then with the aid of Wedgwood's, or any other pyrometer, shew, by calculation, the excess of heat of the Comet over that of red hot iron for the answer.

In Newton's Philosophy by Maclaurin of the year 1748, page 373, it appears, that the Comet of 1680 approached 166 times nearer to the sun, than our earth is; let this Comet therefore be taken for the investigation.

Now the distance of the earth from the sun, 95,000,000 miles divided by 166 times is = 572,300 miles, or distance of the Comet from the sun; consequently, by the above rule inverse, as the square of 572,300 viz. 327,527,290,000 miles to 100 degrees of heat here, so is the square of 95,000,000, or 9,025,000,000,000,000 miles, to 2,755,500 degrees of heat of the Comet.

The degrees in Wedgwood's Pyrometer, are reduced to their equivalent in Farenheit's thermometer by multiplying them by 130, and adding 1,077; because each degree of the former, is equal to 130 of the latter, and Wedgwood's first degree commences at Fahrenheit's 1077th, (vide Fyfe's Elements of Chemistry of

* Vide Ferguson's Astronomy, of 1790, p. 88.

1827, vol. I. p. 19.) Assume 100° of Farenheit, for the measure of the heat experienced on the surface of the earth, by the direct influence of the sun's rays.

It is stated in the work above quoted, that silver melts at 22 degrees of Wedgwood, and as I am not at present exactly aware, at what degree of heat iron becomes red hot, I will assume that of silver, just going into a state of fusion, instead of it*.

Silver melts at 22° of Wedgwood, and 22 multiplied by 130 plus 1077, equal 3,937° of Farenheit*, therefore, the degrees of heat of the Comet, 2,755,500° divided by 3,937°, or heat of melting silver, will make the heat of the former, 700 times greater than that of silver going into a state of fusion.

(Maclaurin, without investigating the truth of the remark, says, the Comet conceived a heat, 2,000 times greater than that of iron almost going into fusion. This must be a mistake, for I find that iron fuses at 158° Wedgwood, = 21,617° Farenheit, so that, using this as a divisor, instead of 3,937°, we obtain only 127½ for the number of times excess of the Comet's heat, over that of iron in a state of fusion).

For gold under the same circumstances, 32° W. = 5,237° F., at which it melts: therefore 2,755,500° ÷ 5,237 = 526 times excess of the Comet's heat over that of gold in a state of fusion.

Tin melts at 442° F. (Fyfe, vol. II. p. 35,) therefore 2,755,500 ÷ 442 = 6,234 times excess of do. over tin. (But at page 21, vol. I. Fyfe says tin melts at 644 F., therefore 2,755.500 ÷ 644 = 4,278 times do. do).

Copper melts at 30° Wedgwood = 4,977° F., therefore 2,755,500 ÷ 4,977 = 554 times for the excess over copper, in a similar state.

Lead at 612° F.; therefore 2,755,500 ÷ 612 = 4,502 times of same over lead in fusion.

I believe Sir Isaac Newton's mode of measuring the quantity of caloric, in heated bodies, was, by their rate or time of cooling, to a degree equal to that of the surrounding medium.

It does not, however, so far as I can see, follow, that the interior, to the very centre of the comet, becomes heated by the sun to so great a degree, as is here indicated, and which affection applies to the surface particularly, for, the time that the Comet is exposed to the sun's rays, its rate of motion being increased in proportion to its proximity to the sun, (so as always to describe equal areas in equal times,) would probably be of insufficient duration, for so large a body to conceive, to its centre, this immense degree of heat; for, the comet has, no doubt, its seasons, and days and nights, as well as the earth, and much free space, almost void of the sun's heat, or even his light, in which to lose its caloric.

Since writing the above, I see by Mr. James Prinsep's experiments in the Asiatic Journal, vol. ii. page 140), that iron heated "uniformly to a glowing red," measured 1609° of temperature, Fahrenheit; if this be used as a divisor, instead of the former denominator, for the melting silver, we shall obtain as follows: 2,755,500 ÷ 1609 = 1712.554 times excess of the Comet's heat over that of red hot iron.

It is evident, that this amount must fluctuate, in exact proportion to the number of degrees, assumed for the measure of the sun's heat, as felt upon this globe, and which I have taken at 100°; but it appears that the sun's heat at Montpelier, raised Amonton's thermometer, on one occasion, to the height of boiling water, or 212° Fahrenheit, (see Hutton's Math. Dict. of 1815, p. 640). This would increase the

* Vide Ferguson's Astronomy, of 1790, p. 88.

above amount (by 2. 12 times) to 3,630 times, but taking the general average heat of the air, in the shade, in hot countries, at $70^0$ only, the amount would be 7-10ths of the above, =1200 times nearly; while for England, assuming $50^0$ as a mean, we have one half of the 1712=856 times excess of heat of the comet of 1680, over that of iron raised to a glowing red: this is tolerably near the 900 times mentioned by the Burmese prince; but the medium heat of air, out of doors in the shade in England, is about 51. $4^0$, so that, multiplying 1,712. 554 above mentioned, by 51,4 = 514 we get 880¼ for the excess of heat, differing only by 19¾ from the answer sought: but we get it nearer, by using the 100dth. part of the mean heat of the thermometer, out of doors, = 51,4 and of that within doors, 52.9 mean = 52-15 instead of the last mentioned ,514dth., for we have 52.15 for the multiplier of 1,712,554, and the product is 893 times, instead of 900 as desired, and lastly, it becomes still nearer, viz. 905.9 times, by using the mean heat within doors or $52^0$.9 as above. This will, I trust, be considered sufficiently near and satisfactory. (N.B. It is equal to the quotient of $(95.000000)^2 \times (572,300)^2 \times$ by $\frac{529}{1609}$).

Afer the above was written, I found in the 1st volume of the Gleanings of Science, page 96, that Mr. PRINSEP has noticed the little reliance which is to be placed on WEDGWOOD's Pyrometer, the degrees of which I have used in the former calculations: this will not, however, affect the answer last given, viz. 905.9 where I have quoted that gentleman's own experiment, so that the statement is left nearly as I had at first written it; but as the measure of temperature, of some of the metals there shewn, differs considerably from the corresponding ones here noted, it is right to state, that in that work the metals are represented to melt, at the undermentioned degrees of heat:

| | | | |
|---|---|---|---|
| Silver at | $4777^0$ F. or its equivalent of | | WEDGWOOD. |
| | $2233^0$ F. ........ | do. | DANIEL. |
| | $1830^0$ F. ........ | do. | PRINSEP. |
| | 1822.7 F. ........ | do. | MORVEAU. |
| Gold at | 2822.6 F. ........ | do. | MORVEAU. |

The degree of heat of the comet above fusing silver, &c. will therefore be as follows, taking $100^0$ for *our* temperature:

| | | |
|---|---|---|
| For melting Silver, | 2,755,500 ÷ 4,777 = 576 times using WEDGWOOD's | measurements of temperature. |
| | 2,755,500 ÷ 2,233 = 1,234 .. do. DANIEL's | |
| | 2,755,500 ÷ 1,380 = 1,505 .. do. PRINSEP's | |
| For Gold. | 2,755,500 ÷ 1,822.7 = 1,611 do. MORVEAU's | |
| | 2,755,500 ÷ 2,517.6 = 1,094 do. MORVEAU's | |

*Correction.*

Instead of 2,755,500 as a numerator, on the assumption of $100^0$ being the heat on the earth, take the medium heat, as before, $52^0$.15, and the quotient of $95,000,000^2 \div 572,300^2$ =or 1,436.990, and divide it by the degrees of the metal, thus;

Than silver fusing, the comet is 308 times hotter, by using WEDGWOOD's degrees 4,777,

| | | | | |
|---|---|---|---|---|
| ——— Do. | 1.436,990÷2,233 | = 643½ times | by DANIEL's | Do. |
| ——— Do. | 1,436,990+1,830 | = $785^0$ ——— | PRINSEP's | Do. |
| ——— Do. | 1,436,990÷1,822.7 | = $788^0$ ——— | MORVEAU's | Do. |
| Gold ...... .. | 1,436,990÷2,517.6 | = $570^0$ ——— | MORVEAU's | Do. |

For iron raised to a full red heat, (1,200°, according to Prinsep,) 1,436,990°÷1,200° = 1,197.5 times, by using Prinsep's degrees.

For do. raised to an orange heat, 1650° P. 1,436,990÷1,650=870 times by ditto.

*Reply to 3rd Question.*

I almost fear to venture an opinion on the next question, but I should say, that the atmosphere is certainly, as the querist supposes, attracted, by the sun and moon, when in conjunction, or opposition, in the same manner, as are the tides of the ocean, or as any other light fluid, would be; but why the barometer is not sensibly affected, at these periods, I can only ask, whether he is sure that it is not so affected, or so much, at least, that a fair conjecture may be hazarded, that its rise is proportional to the increased height of the atmosphere, (if such indeed occur, at the time of high tides,): our purpose will, therefore, be to see, whether the barometer can indicate this rise, or not, and if it do, to determine, what the amount of that difference is.

May not one objection however be made, that will have a tendency to controvert this opinion, which is, that the force, exerted by the moon or sun, or both, to elevate the atmosphere, above its usual level, might, on account of the elasticity, or buoyancy of this body, destroy the additional weight, that would, otherwise, be added to it? In other words, would not the force of attraction, here supposed to cause the additional height, by the hold, (if I may say so,) that it has on the fluid, keep it in equilibrio, without adding any thing to the weight, by the increase of the part so added?

This remark will not, of course, apply to water, but will it not to air, which is an elastic body? If not, then I must resort to the first supposition, that there *is* a rise of the barometer, and that it is proportional to the increased height of the atmosphere, caused by the attraction of the sun and moon.

If the height of the atmosphere were uniform, and of the same weight, as it is at the earth's surface, pressing about 14¾lbs. on the square inch, it would extend no farther than to the height of 5¼ miles, or thereabouts, (see HUTTON's Course, p. 244, vol. ii.) whereas it reaches to between 40 and 50 miles, (the boundaries of twilight only included, the air being so thin and attenuated, beyond that distance, that its comparative weight amounts to almost nothing).

Now, if the height of the atmosphere be increased, by any cause, (excluding heat, which would, however, have something to do with that increase, but has or has not to do with this investigation,) beyond the height of 45 miles, a proportional part must be reduced, in height, on the sides of the earth, which are at right angles to the horizon, acted upon by the sun and moon, to make up for this quantity, unless it be rarefied and of itself kept in equilibrio by attraction, as above supposed: it cannot be very great, but supposing it to be proportionally raised, as much as the sea, what will be the pressure gained, in this, upon one square inch, at the surface of the earth, and also, at what height will the barometer stand, in this case?

Taking 12¾ feet, which is about the height of the tides, or what is added to the ocean, by the attraction of the sun and moon, either when in conjunction or opposition, and assuming ⅓ of a mile, or 1760 feet, as the average depth of the ocean, of which 12¾ feet is near the 138th part; by taking the 138th part of the atmosphere's height of 45 miles, as above, we get .326087 parts of a mile for the additional height of the atmosphere, gained by the force of attraction, consequently, if 45 miles press upon the surface, with a weight of 14¾ lbs. per square inch, 45.326,087 miles will press with a weight of 14.856,884,072 lbs. on every square inch, and then to get the height in inches, gained by the barometer, we have $14\frac{3}{4}$ lbs. to 30 inches, (or general height of the barometer at the level of the sea nearly,) as 14.856,884,072 lbs. to 30.217,4 inches nearly, or .217,4 decimal parts, rather more than $\frac{1}{5}$th of an inch only for the measure of height, gained in the barometer, by the additional weight of the 138th part of the total height of the atmosphere, caused by the attraction of the sun and moon, in a similar manner, and in the same proportion, as the tides are raised above the level of the sea.

Very nearly the same answer is obtained, by considering the atmosphere so condensed, as to have its specific gravity equal to that of water; for, instead of the former height in miles, use $34\frac{1}{2}$ feet height of water, which is equal to the pressure of the atmosphere, and higher than which a common atmosphere pump will not raise that fluid. Then $34\frac{1}{2}$ feet divided by 138 as before is $=$ .25 of a foot, therefore 34.5 feet height of water : 14.75 lbs. pressure on the square inch :: 34.5+.25, (or height of water plus its 138th part $=$ 34.75 lbs.) : 14.856,876 lbs. pressure on a square inch, only exceeding the former 14.856,884,072 by the .000,008,072nd part of a lb. and proving the result of the former calculation to be correct.

In the above investigation, the specific gravities of air and water are taken as equal, but as they differ much*, and as I have no other data, let the height of the atmosphere be considered uniform, for $5\frac{1}{4}$ miles only, as before explained; the calculations will, on the foregoing principle, make the height, gained by the barometer, equal to only $\frac{1}{50}$th part of an inch, which is almost an inperceptible quantity, and shews, that that instrument cannot sensibly indicate the difference of altitude of the atmosphere, due to the attraction of the sun and moon, as supposed by the Burmese Prince; for $5\frac{1}{4} \div 138$ miles$=$.003,804,347,8th part of a mile, when the atmosphere is uniform, and $5\frac{1}{4}$ miles high, therefore, as 5.25 miles : 14.75 lbs. :: 5.25+.003,804,347,8 miles :: 14.760,688,405,7 lbs; and again, $14\frac{3}{4}$lbs. :30 inches :: 14.760,688,405,7 lbs.: 30.021,739,125 inches, or .021,739,125$=\frac{1}{50}$th part only of an inch gained in height by the barometer as above stated.

I subjoin a table of the heights of the barometer, in order that the differences, which I have shewn, for every month, may be observed, at the times of spring and neap tides, in Calcutta, for the satisfaction of the Burmese philosopher, should he think it necessary, to prosecute his inquiries any further into this subject.

***Barometer** at Sunrise, (reduced to* $32^0$ *F.), at the Surveyor General's Office, Calcutta, taken from the As. Soc. Journal, vol.* 1, *for the year* 1832.

| 1832. | Means, In. | | Monthly Diff. | Temperature of Air. | Monthly Difference. | |
|---|---|---|---|---|---|---|
| January, | 30.051 | | .. | 54.6 | | |
| February, | 29.943 | | 108 | 61.2 | 6.6 | |
| March, | 29.865 | | 078 | 66.3 | 5.1 | |
| April, | 29.760 | | 105 | 74.9 | 8.6 | Increase. |
| May, | 29.664 | | 096 | 79.5 | 4 6 | |
| June, | 29.515 | Decrease. | 149 | 80.8 | 1.3 | |
| July, | 29.489 | | 026 | 80.1 | 0.7 | |
| August, | 29.468 | | 021 | 80.0 | 0.1 | |
| September, | 29.650 | | 182 | 79.3 | 0.7 | Decrease. |
| October, | 29.837 | Increase. | 187 | 74.7 | 4.6 | |
| November, | 29.997 | | 160 | 64.9 | 9 8 | |
| December, | 30.998 | | 001 | 55.8 | 9.1 | |

* Viz. a $2\frac{2}{9}$ to 1000.

*Reply to 1st Question.*

Having attempted, as well as I am able, to satisfy the curiosity of the Burmese philosopher, on the above mentioned points, I trust I may, in return, be allowed to put a query or two to him, relating to the moon, as well as to Comets, [which I should, with reference to his question, suppose to have little connection with one another, because, the former is a planet, secondary to, or dependent on, the earth, around which, she describes her epicycloidal course; the earth, again, being dependent on the sun, and the sun appearing to govern the Comets, as they are all believed, or found, to pass round him ] : if his highness cannot answer these questions, I hope that some other person, equally anxious for such investigations, will favour me by doing so.

*Question 1st.*

Why may not such comets as we know of, especially those, which have extremely elongated elliptical orbits, be considered, to possess two centres or foci within their orbits, one of them being our sun, and the other, any other sun, or star. Would not this disposition, supposing it to have been adopted all over the universe, have the effect of keeping the numerous systems in equilibrio, the comet incessantly acting as a link, or chain, connecting any two [or more ?] of these systems, with the neighbouring ones ?

*Question 2nd.*

If the moon have no atmosphere, [as is asserted by astronomers,] how is it possible to account for the distinct view, we sometimes obtain, of the circular dark part, which she presents at night; I mean, that part which is involved in shadow when the moon is in either her first or her last quarter ?

*Question 3rd.*

Has it ever been ascertained, in what proportion, fluids are attracted, by the sun and moon, [or by any other bodies,] in terms of their specific gravities?

Are they, or are they not, attracted, inversely as the cube roots of their specific gravities; the distances of each fluid, from the centre of attraction, being equal ?

*Camp near Calpie, June,* 1833.

I am, your obedient servant,

W. BURT, Engs.

To the Secretary, Phl. Class, Asiatic Society, Calcutta.

[EUROPEAN EXTRACTS.]

9.—*Cave of Secanderiah, near Tabriz.*

As the celebrated Cave of Secanderiah, resembling the Grotto del Cane in Italy, was only distant six miles, I proceeded to the village of Secanderiah, situated at the mouth of a very strong defile, formed by the river of Sied-abad; and having procured a numerous party of villagers with tools, combustibles, &c., set out determined fully to examine the cave, or at least to ascertain to what extent the noxious vapour existed; we also took some fowls to see the effect procured on them. After a fatiguing walk of three miles, up rocky steep ravines, we arrived at the entrance of this singular cavern, the mouth of which was fifty feet wide and thirty feet high, descending very rapidly to a depth of thirty feet.

The guides set fire to some brushwood, and found the air much less noxious than usual; and it was only after a descent of 10 feet that we felt any inconvenience. We were absolutely standing on the bones of some animals which had perished there upon a former occasion; we remarked a dog, a deer, and two foxes: the head of a wolf lay at some distance. We, at the same time, put to flight a great number of pigeons, who build in the roof of the cave. We found that fire was extinguished at a few feet below where we stood, and the fowls died in half a minute. The sides of the cave had many marks of sulphur in powder amongst the soft sand and limestone, which were also strongly coloured with iron. Though the fire made with dry brush-wood and thorns, even when sprinkled with naphtha, was instantly extinguished, port fires and fuses burnt nearly the same time as in the open air. I was, therefore, enabled to fire a quantity of gunpowder at the very bottom. The quantity amounted to several pounds at the time, and that repeated often, had the effect of so entirely filling the cave with smoke, that we could no longer see any thing at the bottom. On again throwing in some fowls, they soon made their escape, and fire burnt at the bottom. I would not, however, allow any of the people to descend, which they appeared willing to do; a dog also ran in and returned in a few minutes. On a former occasion, when this cave was visited by a party of the Mission, accompanied by Mr. BROWNE, the celebrated African traveller, fire would not burn two feet below the entrance, and oppression was felt close at the mouth of the cave. Mr. BROWNE entered some paces by holding his breath, but an English officer attached to the Mission had nearly perished in attempting to follow him. He was instantly dragged out, and recovered with some difficulty. In the winter (subsequently to my second visit), after a strong gale, the wind from the N. W. had blown for some days directly into the mouth of the cave: we were enabled to walk all over it, and only in a deep hole, at the bottom, did there exist any noxious air. There a fowl died in two minutes, and from its cries appeared to suffer much. After sixty feet, we found the cave again ascended, and curved a little to the right: it then became exceedingly narrow and very low, forming a kind of passage, which did not allow of standing up; we could not see to the end of this even with a reflecting lamp, and none of us felt inclined to prosecute the discovery. I have only mentioned these circumstances to prove how much the extent and force of the vapour are affected by the state of the atmosphere, and by particular circumstances. As the ground slopes rapidly from the mouth of the cavern, both to the ravine and inwards, it might be cleared away with little difficulty, and the heavy noxious gas thus allowed to pass off; but with the exception of forming a large winter stable for sheep, no other good purpose could be answered by it; there was formerly a human skeleton, which has been removed; it was that of an old man in the village, who, tired of life, took this way of ending his misery; the peasants considered the circumstances of the cave being accessible little short of a miracle, but were much disappointed at not finding the treasure said to have been deposited there by ALEXANDER, from whom it derives its name.—*Monteith's Tour. Jour. Geog. Soc.* iii. 6.

*Meteorological Register, kept at the Assay Office, Calcutta, for the month of December,* 1833.

| Day of month. | Barometer reduced to 32° Farh. | | | | Thermometer in the Air. | | | | | Depression of moist-bulb Thermometer. | | | | Hair Hygrometer. | | Rain. | Wind. | | | Weather. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 4½ A.M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Minimum at 4½ A. M. | At 10 A. M. | Max. by Reg. Ther. | At 4 P. M. | At 10 P. M. | At 4½ A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | At 10 A. M. | At 4 P. M. | Inches. | Morning. | Noon. | Evening. | Morning. | Noon. | Evening. |
| 1 | ,957 | ,030 | ,919 | ,962 | 64, | 73,8 | 83,8 | 77,8 | 69,2 | 5,0 | 8,2 | 11,0 | 6,4 | 83 | 77 | | o. | n. | n. | clear. | cumuli. | clear. |
| 2 | ,927 | ,016 | ,878 | ,918 | 64,5 | 74,4 | 82,7 | 78,5 | 69, | 1,5 | 6,5 | 9,4 | 2,9 | 86 | 82 | | s. w. | n. | o. | fog. | clear. | fog. |
| 3 | ,901 | ,980 | ,880 | ,922 | 66,1 | 75,8 | 87,0 | 78,2 | 69,8 | 2,9 | 6,7 | 8,6 | 2,5 | 87 | 85 | | o. | n. e. | s. e. | fog. | do | fog. |
| 4 | ,914 | ,000 | ,871 | ,901 | 67,3 | 76,0 | 84,0 | 80,4 | 71,8 | 2,9 | 6,0 | 9,0 | 4,5 | 91 | 83 | | n. | n. e. | s. | cum. cir. | do | clear. |
| 5 | ,880 | ,950 | ,860 | ,882 | 65,7 | 76,6 | 82,5 | 80,0 | 72,2 | 1,5 | 5,7 | 7,4 | 4,0 | 90 | 87 | | o. | n. | S. | fog. | cl. str. | overcast. |
| 6 | ,840 | ,926 | ,813 | ,865 | 71,2 | 77,7 | 81,1 | 78,2 | 70,0 | 2,2 | 4,3 | 4,5 | 0,8 | 96 | 94 | 0,25 | s. e. | S. | S. | clear. | m. cm. str. | bright. |
| 7 | ,871 | ,984 | ,873 | ,951 | 66,7 | 75,2 | 84,0 | 77,4 | 68,2 | 0,7 | 5,7 | 8,4 | 5,2 | 90 | 81 | | o. | S. | e. | do | clear. | clear. |
| 8 | ,928 | ,040 | ,830 | ,977 | 63,2 | 72,8 | 81,5 | 75,0 | 64,8 | 2,1 | 7,9 | 8,0 | 3,6 | 81 | 81 | | e. | N. | n w. | do | do | do |
| 9 | ,923 | ,000 | ,888 | ,949 | 60,0 | 71,9 | 84,1 | 74,7 | 62,7 | 2,8 | 7,1 | 9,6 | 3,7 | 81 | 78 | | n. | N. | S. | do | do | do |
| 10 | ,907 | ,980 | ,853 | ,879 | 60,2 | 71,3 | 83,7 | 75,1 | 67,2 | 3,0 | 6,8 | 8,6 | 5,2 | 85 | 81 | | o. | N. | o. | do | do | do |
| 11 | ,826 | ,943 | ,852 | ,929 | 64,0 | 72,8 | 81,4 | 76,6 | 70,2 | 2,2 | 5,5 | 5,4 | 2,0 | 91 | 92 | | o. | e. | E. | do | overcast. | do |
| 12 | ,925 | ,978 | ,879 | ,912 | 67,8 | 75,5 | 83,0 | 78,7 | 63,8 | 0,7 | 4,5 | 6,0 | 0,8 | 95 | 90 | | E. | E. | n. e. | cir.stratus. | do | do |
| 13 | ,914 | ,970 | ,880 | ,939 | 63,5 | 74,0 | 87,0 | 77,8 | 67,2 | 0,8 | 5,5 | 9,6 | 1,1 | 90 | 80 | | o. | n. | n. e. | clear. | clear. | do |
| 14 | ,916 | ,020 | ,908 | ,983 | 60,4 | 72,4 | 84,0 | 76,8 | 65,8 | 0,4 | 5,6 | 6,5 | 2,0 | 90 | 89 | | n. | n. w. | N. | do | do | do |
| 15 | ,946 | ,032 | ,947 | ,008 | 61,8 | 73,0 | 78,4 | 75,0 | 66,7 | 1,4 | 5,5 | 6,2 | 3,4 | 91 | 90 | | n. | n. w. | n. | do | cumuli. | do |
| 16 | ,989 | ,006 | ,924 | ,976 | 65,0 | 72,7 | 84,0 | 74,6 | 69,2 | 2,9 | 5,6 | 7,8 | 6,0 | 92 | 85 | | o. | n. | n. | cirri. | do | do |
| 17 | ,917 | ,988 | ,900 | ,974 | 65,4 | 71,7 | 78,7 | 74,7 | 68,3 | 5,0 | 6,0 | 7,4 | 4,8 | 89 | 85 | | n. | n. | n. | clear. | overcast. | cum. strat. |
| 18 | ,926 | ,986 | ,908 | ,945 | 64,0 | 72,7 | 74,5 | 74,4 | 68,2 | 0,8 | 4,5 | 5,0 | 2,1 | 94 | 94 | 0,20 | E. | n. e. | o. | cloudy. | m. cumli. | fog. low. |
| 19 | ,920 | ,004 | ,915 | ,957 | 63,5 | 71,5 | 85,3 | 74,7 | 67,8 | 1,4 | 4,5 | 5,8 | 4,6 | 95 | 91 | | o. | n. | N. E. | clear. | clear. | clear. |
| 20 | ,897 | ,941 | ,829 | ,959 | 63,0 | 72,1 | 74,6 | 71,8 | 64,0 | 3,4 | 5,6 | 3,0 | 0,3 | 91 | 96 | 2,10 | n. e. | E. | n. | misty. | hard rn. | rain. |
| 21 | ,860 | ,984 | ,900 | ,969 | 63,6 | 70,2 | 78,6 | 71,7 | 65,2 | 1,0 | 3,5 | 4,7 | 1,9 | 96 | 94 | | w. | n. | n. | cloudy. | overcast. | clear. |
| 22 | ,949 | ,064 | ,970 | ,048 | 61,2 | 70,4 | 78,3 | 71,4 | 65,7 | 0,8 | 4,6 | 5,4 | 4,5 | 93 | 90 | | o. | n. | n. | clear | nimbi, | do |
| 23 | ,011 | ,092 | ,960 | ,010 | 61,2 | 68,6 | 76,0 | 70,3 | 64,0 | 3,2 | 5,4 | 7,5 | 5,0 | 90 | 82 | | o. | n. | n. | do | clear. | do |
| 24 | ,977 | ,045 | ,870 | ,920 | 60,3 | 68,5 | 78,0 | 71,2 | 68,0 | 3,3 | 4,8 | 6,2 | 4,0 | 92 | 88 | | n. | n. | o. | do | do | fog. |
| 25 | ,862 | ,000 | ,848 | ,894 | 65,1 | 68,8 | 87,3 | 71,2 | 65,8 | 4,0 | 5,0 | 4,4 | 2,4 | 95 | 95 | 0,02 | S. | S. | W. | nimbus. | cumuli. | cumuli. |
| 26 | ,886 | ,000 | ,922 | ,026 | 61,8 | 69,1 | 81,7 | 70,0 | 61,2 | 2,7 | 5,6 | 8,2 | 4,7 | 89 | 80 | | o. | n. w. | n. | cir. cum. | clear. | clear. |
| 27 | ,999 | ,115 | ,994 | ,032 | 55,6 | 67,6 | 85,1 | 68,8 | 61,8 | 3,2 | 6,0 | 8,5 | 2,8 | 86 | 79 | | n. | N. W. | o. | clear. | do | do |
| 28 | ,986 | ,092 | ,970 | ,017 | 57,1 | 66,2 | 86,2 | 69,6 | 64,3 | 2,1 | 6,7 | 8,5 | 1,9 | 84 | 80 | | o. | N. W. | w. | do | do | cum. cirus. |
| 29 | ,976 | ,085 | ,971 | ,993 | 58,1 | 66,4 | 76,8 | 70,0 | 65,1 | 2,9 | 6,5 | 8,0 | 1,7 | 86 | 81 | | o. | N. W. | o. | do | do | do |
| 30 | ,994 | ,082 | ,972 | ,022 | 62,0 | 66,7 | 89,5 | 70,2 | 64,8 | 2,2 | 6,3 | 7,5 | 2,6 | 88 | 83 | | o. | N. E. | n. e. | cloudy, | do | stratus. |
| 31 | ,012 | ,112 | ,000 | ,050 | 58,2 | 67,0 | 89,0 | 70,4 | 65,0 | 2,2 | 6-8 | 7,6 | 2,5 | 85 | 8 | | n. | N. | n. | cl ear. | do | clear. |
| Mean, | 29,927 | ,014 | ,906 | ,957 | 63,0 | 71,7 | 82,3 | 74,3 | 66,7 | 2,3 | 5,8 | 7,2 | 3,2 | 89,4 | 85,7 | 2,57 | day breezes. | | | sharp cold weather. | | |

The instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory; those for 4½ A. M. and 10 P. M. in the south veranda of a third story near the cathedral. The Barometers both stand .044 lower than the Surveyor General's.

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